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THE RODEO METEORITE.

BY OLIVER CUMMINGS FARRINGTON.

This meteorite is an iron mass found about 1852 by a goat-herder in an arroya north of the Nazas River, 12 kilometers northwest of the hamlet of Rodeo, State of Durango, Mexico. The location is approximately 25° 20′ N. lat. and 104° 40′ W. long. Upon discovery of the iron it was made to do duty as an anvil at a forge for many years. As received at the Museum, evidence of its industrial use was to be seen in its having been beaten flat and smooth on one side. The surface so treated is apparent in Plate II., by its smoothness and turned-over edges. The meteorite as a whole is irregular in form and without marked orientation. Its extreme dimensions are 12 x 9 x 8 inches (30 x 23 x 20 cm.). Its weight when received was 97 pounds (44.1 kgs.). An attempt had evidently been made at some time to cut off a portion of the mass with a cold-chisel, thus producing the incision shown in Plate I. Above this a small surface appears that was filed smooth for etching. In other respects the surface of the meteorite has the natural contours. The surface in general, though irregular, is everywhere rounded, showing no angular or sharp edges. There are many partially defined pittings of various depths and diameters, the largest of these having an elliptical outline and being 4 inches (10 cm.) in length, 3 inches (8 cm.) in width, and about 1½ inches (4 cm.) in depth. The position and character of this pit are shown in Plate I. In color the surface of the meteorite is darkened by exposure, but it has nowhere rusted deeply, and in several places the nickel-white color of the metal is visible. In such places Widmanstätten figures often can be seen also. On any polished surface of the meteorite, too, the figures appear nearly as plainly as after etching.

Several complete sections of the meteorite were made in order to determine its interior structure. All show on etching well-defined figures octahedral in character. A photograph of one of these etched sections is shown in Plate III. The bands (Balken) are more numerous than the meshes (Felder), yet the latter occupy a considerable amount of the total area. Through a belt about two inches (5 cm.) in width running across the middle of most of the sections a minutely dotted appearance is presented resembling that described by Brezina

as characterizing Charcas* and referred by him tentatively to minute inclusions of troilite. An examination of the dots in Rodeo with the lens shows them to be minute, shallow, saucer-shaped pits. They are scattered irregularly along the bands of kamacite, and are to be seen in some of the swathing kamacite, but never in the plessite. The tendency of the iron to rust at these points is greater also than at others. They appear therefore, to mark the occurrence of some more soluble ingredient in the kamacite. This is probably not troilite, but may be an iron containing less nickel than the kamacite. The lamellæ of the meteorite may be grouped into two classes; one about 1 mm. in width, swollen, and with wavy outlines, and the other about half as wide, and with more nearly rectilinear outlines. As a rule, these two kinds of lamellæ have a different orientation as compared with each other. The kamacite is granular, much lighter in color than the plessite. A considerable quantity of swathing kamacite is present. While in general it follows the outline of the inclusions and forms a narrow border to them, at times its outer border is quite independent of the shape of the inclusions and it covers relatively broad areas. The tænite is well developed, silver-white in color, and displays the structure of a section brilliantly on holding one at an angle to the light. The plessite is not depressed by etching as is the kamacite. At times it occupies the meshes alone, while again the meshes may display elaborate combs resulting from skeleton growths of tænite. Scattered irregularly through the sections and forming an important feature in the structure of the meteorite, occur numerous inclusions of schreibersite. The form of these inclusions, especially those of large size, is in general elongated, and rectangular or spindle-shaped. Some of the smaller inclusions, however, are star-shaped, while others have no well-defined form. The largest inclusion noted (shown in the upper right-hand corner of Plate III.) has a length of one and a half inches (4 cm.) and a width of one-fourth of an inch (.5 cm.). The schreibersite is tin-white in color, brittle, and magnetic, and affords the usual blow-pipe and chemical tests for that mineral. The inclusions are always bordered by a band of swathing kamacite about 1.5 mm. in width. The inclusions, while having no apparent regularity of arrangement among themselves, are usually disposed, especially the elongated ones, parallel to the Widmanstätten figures, or in other words, the octahedral structure of the meteorite. This can well be discerned by a study of Plate III. Another inclusion of an interesting character found in one of the sections was a nodule about one centi-

*Wiener Sammlung, 1895, p. 275.

meter in diameter, of a black, amorphous, friable substance resembling graphite. The form of the nodule in the direction of the section is nearly circular, but in the third dimension its extent is unknown, as it penetrates into the main body of the meteorite, which has not yet been cut. No band of swathing kamacite surrounds the nodule, it being set bodily into the mass of the iron. In appearance and physical properties the substance of the nodule resembles graphite fully, but it is magnetic and fuses in the reducing flame at about 4. Mixed with potassium nitrate it deflagrates readily, but throws out incandescent sparks in addition to the flaming usual to graphite. Potassium carbonate results from the reaction. Oxidation with sulphuric and chromic acids according to the French method* affords an appreciable quantity of CO_2. On heating in oxygen the substance glows and becomes of a red-brown color. It was found to be little, if any, attacked by the ordinary acids. After a long treatment with aqua regia, however, and addition of ammonia to the solution, a slight precipitate of iron hydroxide was obtained. When powdered and added to a copper sulphate solution, copper was reduced by the substance. Its specific gravity (obtained by Thoulet's solution) was 2.38. On account of the above properties it would appear that the substance is chiefly graphite, but contains in addition some form of iron, probably a carbide, intimately mixed with it. Such a mixture should exhibit the properties of magnetism, reduction of copper from copper sulphate and insolubility in acids, which are possessed by this substance. Such properties seem not to have been possessed by graphite which has been described from other meteorites. It is common for meteoric graphite to be accompanied by troilite, as has been noted by Smith† and other authors. The Rodeo graphite, however, seems to contain no troilite. A specimen labelled graphite in the Museum collection of what is probably a portion of a "salamander" from the Isabella Furnace, Etna, Pennsylvania, was found to exhibit properties much like those of the Rodeo graphite except that it is heavier, the specific gravity being 5.56, and the structure is foliated rather than compact. Since a "salamander" originates by the accumulation of graphite and graphitic substances in smelting operations, it seems reasonable to suppose that the Rodeo nodule is a similar segregation of graphite originally more or less disseminated in the iron.

An analysis of the meteorite was made by Mr. H. W. Nichols, of the Department of Geology of the Museum. Material for analysis was secured by drilling a half-inch hole to a depth of seven-eighths

* Blair, The Chemical Analysis of Iron, third edition, p. 136.

† Am. Jour. Sci. 3, 2, p. 394, 433.

of an inch, and rejecting the drillings from the crust portion. For the determination of iron, nickel, and cobalt, a portion of 1.3733 grams was dissolved in strong hydrochloric acid. Solution took place rapidly and completely, only a few unweighable black flecks being left after oxidation with nitric acid, evaporation to dryness and addition of water. Iron was precipitated three times by treatment with ammonia and ammonium chloride as directed by Fresenius, except that a large excess of the reagents was used. After solution with sulphuric acid and reduction with hydrogen sulphide, the determination was made by the usual titration with potassium permanganate. Copper was precipitated by hydrogen sulphide from the filtrate from the iron precipitate and then determined electrolytically. Nickel and cobalt were separated in acetic acid solution as sulphides and separated by potassium nitrite. Nickel was then determined electrolytically, but cobalt as sulphate, the electrolytic determination of this element having proven at times unreliable. Manganese was tested for in a portion of 2.8248 grams dissolved in nitric acid and oxidized with potassium chlorate according to Ford's method. No precipitate was obtained. The treatment with nitric acid showed the meteorite to be passive until water was added. Sulphur and phosphorus were determined in a portion of 4.8321 grams dissolved in fuming nitric acid by the slow addition of hydrochloric acid. From this sulphur was precipitated as directed by Blair when iron is present, purified by fusion with sodium carbonate, and weighed as barium sulphate. Phosphorus was determined by the acetate method and weighed as magnesium pyrophosphate. Carbon was determined in a portion of 2.5678 grams by oxidation with chromic and sulphuric acids and weighed as carbon dioxide. During the treatment the odor of hydrocarbons was observed, similar to that obtained in the solution of pig iron. This indicated that some of the carbon was present in a combined form, while an insoluble residue showed that some existed as graphite. The analysis gave the following results:

Fe	89.84
Ni	8.79
Co	0.28
Cu	0.07
P	0.80
S	0.02
C	0.09
	99.89

The composition of the meteorite is thus seen to be that usual to medium octahedrites, with a high percentage of phosphorus. From

the large amount of schreibersite visible in the sections, such a content of phosphorus would be expected.

Including Rodeo, the meteorites now recognized from the State of Durango are, with dates of their fall or find, as follows:

Avilez, Spherulitic chondrite, Cc	1856
Bella Roca, Fine octahedrite, Of	1888
Cacaria, Hammond octahedrite, Oh	1867
Rodeo, Medium octahedrite, Om	1852
Rancho de la Pila, Medium octahedrite, Om	1804
San Francisco del Mezquital, Siratik ataxite, Ds	1868

The localities of these have been determined as accurately as possible by the writer from various published accounts, and are represented as determined on the accompanying map (Plate IV.). Of these meteorites only one, Avilez, is a stone; the others are all irons. Of the irons, Cacaria and San Francisco del Mezquital are sufficiently distinguished by their structure, Cacaria being a Hammond octahedrite and San Francisco del Mezquital an ataxite. Rodeo and Rancho de la Pila are both medium octahedrites, but the localities from which they come are about seventy miles apart. Hence only Bella Roca needs to be compared with Rodeo in order to determine whether it belongs to the same fall. The localities of Rodeo and Santiago Papasquiaro, near which Bella Roca is said to have been found, are in a direct line about forty miles apart. This is much farther than parts of a single meteor could have been naturally distributed according to our present knowledge. That they might have been separated by human agency is possible, but not probable, since the country between these localities is thinly settled and difficult to travel over. From the appearance of the surface of the Bella Roca meteorite Brezina concluded* that it could have lain exposed but a little while. The Rodeo meteorite, however, is known as far back as 1852. Brezina also describes Bella Roca as a highly oriented individual showing an almost complete fusion crust. Neither of these observations would apply to the Rodeo iron. From the point of view of structure the two irons do not differ essentially. The appearance of the lamellæ is indeed quite similar, with the exception that Rodeo has a preponderance of the wider lamellæ, sufficient, in the author's opinion, to warrant classing it as a medium octahedrite. Bella Roca is classed as a fine octahedrite by Brezina. There is also a similarity between the two irons in the fact that the schreibersite inclusions follow the octahedral lamellæ, in their orientation. The schreibersite in Rodeo,

* Wiener Sammlung, 1895, p. 271.

however, is considerably stouter in habit than that in Bella Roca. The chief point of difference between the two irons, however, and one which in the writer's view seems alone to warrant their separation, is that in Rodeo there is an entire lack of the inclusions of troilite which form so striking and important a feature of the composition of Bella Roca. Although eight full-sized sections have been made of Rodeo, no troilite has as yet been observed in it. In Bella Roca, however, as is well known, troilite is an abundant and characteristic constituent. The chemical analyses of the meteorites do not show important differences, but this would not be expected as between medium and fine octahedrites. Still the analyses show a relative absence of sulphur and hence of troilite, and abundance of phosphorus and hence of schreibersite in Rodeo, while the opposite condition holds in Bella Roca. The analyses compare as follows, that of Bella Roca being by Whitfield:*

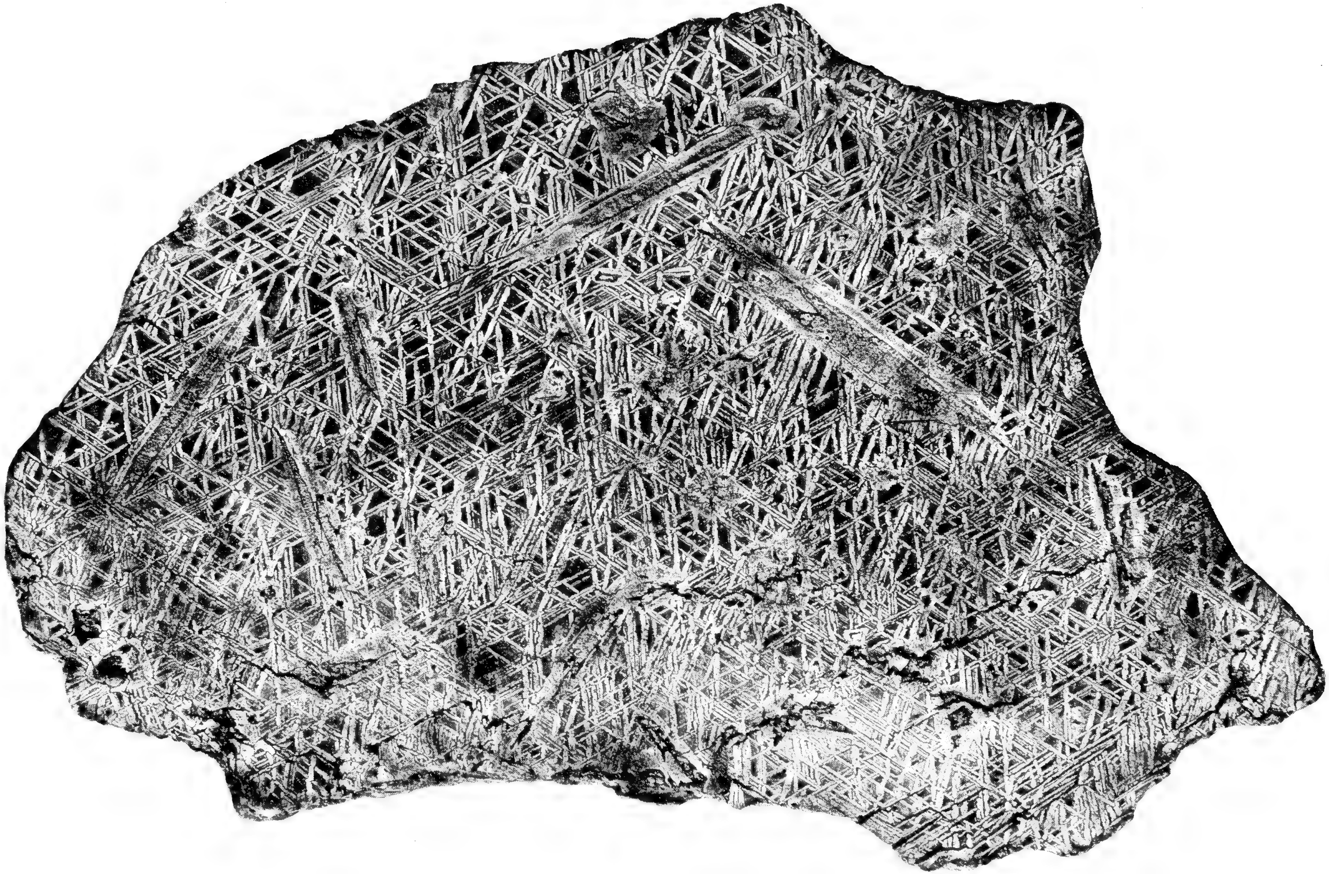
	Fe	Ni	Co	Cu	P	S	C	
Bella Roca..	91.48	7.92	0.22	——	0.21	0.21	0.06	= 100.10
Rodeo......	89.84	8.79	0.28	0.07	0.80	0.02	0.09	= 99.89

In view, therefore, of the distance between the localities and the difference in structure and composition, there seems to be sufficient reason for regarding Rodeo as a distinct fall.

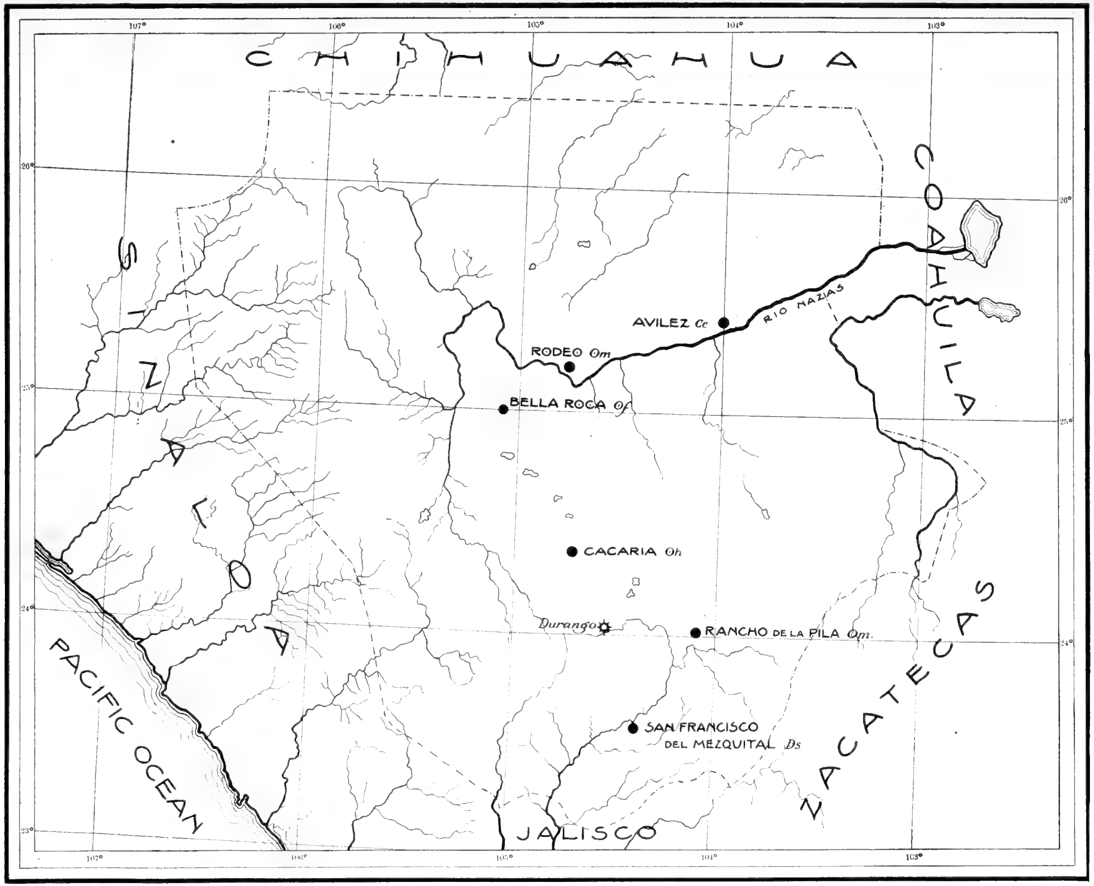
* Am. Jour. Sci. 3, 37, p. 439.

The Rodeo Meteorite. x ½. The incision and smoothed surface in the upper right-hand corner are of artificial origin. The remainder of the surface presents the natural appearance.

The Rodeo Meteorite. x ½. The smoothed surface at the left is due to the use of the meteorite as an anvil.



Etched section of the Rodeo Meteorite. x ⅝. The inclusions are schreibersite surrounded by swathing kamacite.



Map of the State of Durango, Mexico, showing location and character of known meteorites.

THE SHELBURNE METEORITE.

BY OLIVER CUMMINGS FARRINGTON.

The Shelburne meteorite fell about three miles from Shelburne, Ontario, at 8 P. M. August 13, 1904. Two stones were obtained from the fall, one of which weighed 12.6 kg. (27¾ lbs.) and the other 5.6kg. (12¼ lbs.). The latter of these stones came into the possession of his Museum, where it is preserved under the Museum number, Me. 606.

The general phenomena of the fall and the larger stone have been described by Borgström** (Trans. Royal Astronomical Society of Canada, 1904, pp. 69-94). It remains to describe the smaller stonc and give some additional general observations regarding the fall. The distance between the points of fall of the two stones was about three-quarters of a mile and the direction between them a southeast-northwest one, the smaller stone being at the southeast. The latter stone fell within eighteen inches of the rear porch of the residence of Mr. John Shields. The phenomena of the fall, as stated by Mr. Shields to the writer, were that sounds like a muffled drum-beat were heard by various members of the family who were in the house at the time, followed by a dull thud at the rear of the house. A man at the barn, two or three rods west of the house, also saw a momentary light. Mr. Shields' impression from the noise was that an old shed in the rear of the house, shown in Fig. 1, had fallen. He accordingly investigated to see if this were true. The shed proved to be intact, but a hole newly made was noticed in the soil near it. It was also noticed that the side of the house south of the hole was splashed with mud. No one investigated farther at the time, but on the morning of the second day (August 15) Mr. Shields dug into the hole and at a depth of eighteen inches* found the stone here to be described. A portion of a burdock leaf, which had evidently been carried into the hole with it, lay under the stone. This showed no evidence of charring or burning.

*(4m. or 16 inches according to Borgström, but judgment might well differ as to the exact depth.)

The character of the soil in which the meteorite fell was clayey. and no other stones were observed while digging it up. The meteorite lay with the side shown in Plate V, down. The weather at the time was fair, but there had been a shower a few hours previous. The mud splashed by the meteorite against the house was seen by the writer when he visited the locality six months after the fall, in February, 1905. The mud had been thrown in considerable quantity across the porch, a distance of about three feet, upon a

Fig. 1. Place of fall of the Shelburne meteorite. A board marked by the star stands in the hole from which the meteorite was dug.

window, and was even to be seen on the lower side of the roof of the porch at a height of about eight feet. The direction in which the mud was thrown was southeast from the point where the meteorite fell. The shed shown in Fig. 1, was six and a half feet from the point of fall. The height of this shed is twelve feet. It stands north of the house, and northwest of the point of fall of the meteorite. A line drawn to the point of fall of the other stone would pass directly over the roof of this shed so that had the direction of fall of the smaller stone been at a low angle with the horizon, it would have struck the roof. Calculation shows that the angular altitude of the meteorite must have been at least 26° to

allow it to clear the shed, if it came from the northwest. If its movement was in the opposite direction, *i. e.* toward the northwest, it must have fallen nearly vertically to have avoided striking the roof of the porch. This fact, together with the noticeable throw of mud to the southeast, indicates that the path of the meteor was toward the southeast. If this view be correct, the larger stone fell first, which is contrary to the usual rule, and, contrary to what would be expected, since the greater momentum of larger stones usually carries them farther. It is possible in this case that the bursting of the meteor caused a deviation of motion which brought the larger stone to the ground first. The accounts of those who saw the meteor pass seem to be of no value for determining the direction of motion. In the reports quoted by Borgström four observers assert that the meteor was traveling northwest and three that it was traveling southeast. A similar conflict of opinion was found by the writer to exist among those at Shelburne who saw the meteor. A point on which all witnesses agreed, however, was that several reports were heard, at least as many as three. This would indicate that the meteorite broke into more pieces than were found.

The stone found by Mr. Shields, and now in the possession of the Museum, has a shape resembling that of a flat-iron. Its length is 10 inches (25 cm.), its width 5½ inches (14 cm.) and its thickness 3 inches (8 cm.). The several surfaces show differences of crust and rugosity, which indicate the orientation of the meteorite. Thus, of the broad surfaces, one, that shown in Plate VI, is smooth, and has only broad, shallow pits. This was the surface found uppermost when the meteorite was dug up, and is plainly the rear side of the meteorite. The opposite surface, shown in Plate V, is for the most part peppered with small, irregular pits and the crust is thinner. It is not as smooth as the side previously described. It seems evident from the character of the crust and the pittings that not only was this the front side of the meteorite in falling, but that a piece corresponding in outline to the rough portion was split off during the fall. On the lower side of the surface in the position in which the meteorite stands in Plate V, the interior of the meteorite is seen, over two areas, each covering about a square inch. Of these areas the one at the right was produced by a piece having been chipped off for examination when the meteorite was first found. The one at the left, triangular in shape, is a natural scaling which, since it is not encrusted, must

have been made about the time the meteorite struck the earth. It passes along the plane of a nickel-iron-troilite vein such as appears in other parts of the meteorite, and the position of this vein doubtless determined the fracture. Of the narrow surfaces of the meteorite, one, that shown in Plate VII, has a rugose character and incomplete crust similar to that of the front side of the meteorite. Here, evidently, the meteorite split off from some other mass during its descent to the earth. The other narrow surfaces, shown in Plate VIII, have a complete crust and rounded edges. Their pittings are few and irregular and show rounding and smoothing.

By means of a cast of the larger stone, kindly furnished the Museum by Dr. Borgström, it was possible to determine in what manner the two stones may have been joined together. The rear and front sides are so plainly marked on both stones and the surface of mid-atmospheric fracture so evident in the smaller one that there is little difficulty in deciding that the stones were joined together in the manner indicated in Plates IX and X. Of these, Plate IX shows what, in the view of the writer, was the front side of the meteorite in its descent and Plate X the rear side. This determination does not however, accord with that of Borgström; for the larger stone. Borgström reverses them,* basing his determination chiefly on the fact that on what he regards as the rear side, the apparent directions of flow of molten matter point in a general way toward the center of the mass. These directions of flow are determined by a heaping of the crust on the sides of the pits. Such indications, however, are liable to be deceptive. Several pits on the smaller stone show drift phenomena in one direction or another which, in the present writer's view, are to be regarded as remains of flows from the centers of the pits outward. These flows probably take place in all directions but leave traces only here and there. All the other characters of the side regarded by Borgström as the rear one seem without question to be those of the front. It has a generally arched or conical character, a relatively large extent of surface, and deep pits. These are well known characters of the front side of oriented meteorites. Moreover, if this were regarded the rear side, the side which must be taken for the front is one having a form concave toward the direction of movement through the air. It is hardly conceivable that the mass could have come through the air with its concavity foremost. The form obtained by joining the two stones

*Op. cit. p. 84.

together in the manner indicated in Plates IX and X is a somewhat conchoidal one, indicating a scaling off from a larger mass. Such a form, as is well known, is exhibited by other meteorites, notably that of Butsura among stones and Cañon Diablo among iron meteorites. Such a form would be especially liable to fracture during descent. Borgström remarks that the larger stone is characterized by concave surfaces. This is also true of the smaller one, and of Butsura as well. The two parts when placed together in the manner indicated in Plates IX and X correspond perfectly as regards front and rear sides. The rear side of each is concave, smooth, and has broad, shallow pits. The front side is concave, rough, and has small, deep pits.

The pittings of the two surfaces of the smaller stone shown in Plates V and VII differ in character from those of the other surfaces. These surfaces may be said to be rougher than the others in the sense that the roughness is due to a greater abundance and smaller size of the pittings. The shape of the pittings is irregular, but in general, saucer-like with diameters of .5 to 1 centimeter. On the face shown in Plate VII the pittings tend to become elongated in character, with the long axes parallel with the long direction of the surface. The edges which both these rough surfaces make where they join the other surfaces of the meteorite are much sharper than the edges of other parts of the meteorite. These sharper edges and roughness indicate less exposure to fusion and erosion, and therefore a mid-atmospheric fracture along these surfaces. The largest pits on the meteorite are on the surfaces shown in Plate VIII. One depression here shows an area of about 3x3 cm. and a depth of 1 cm. Secondary pits break the configuration of this, but all have sloping, rounded edges, showing fusion and erosion during the entire aërial passage of the meteorite. The depressions on the rear side, that shown in Plate VI, are still broader and shallower in character and blend in with the general surface so as to nearly lose the character of pits.

The crust of the meteorite is uniformly black in color. While in general smooth in appearance, it is seen even with the naked eye to be dotted over with minute grains rising above the general surface. These are for the most part protruding metallic grains whose bright surface can be discovered by filing. Besides these the crust may be seen under a lens to be abundantly stippled with clots and threads which anastomose and blend with one another, producing hollows and elevations. The threads rarely extend more than a few milli-

meters independently and are usually very minute. The appearance of the substance of the crust is like that of black obsidian, being black, opaque and of pitchy luster. The crust adheres firmly throughout to the interior, showing no tendency to scale. There is a noticeable uniformity in the direction in which the threads of fused matter run on the different faces. Such directions are shown in some of the photographs, notably Plates V and VII. In the face shown in Plate VII it is observable that the drift is in the direction of greatest length along the middle line, with diversions to the rear side. If a feather, the barbs of which had been removed from one side of the midrib, were laid along the surface the directions of the remaining barbs would indicate quite accurately the directions of drift. The drift on this face may therefore be described as pinnate. On the face shown in Plate V there is drift radiating from the center outwards. On the face shown in Plate VI, or rear side of the meteorite, the drift tends to follow the direction of greatest length, though modified by radiation outward from the pits.

The crust studied in thin section under the microscope shows nearly all the zones described by Borgström. The first, third, and fourth are manifest, but the second zone, or "thin brownish layer," which he describes, is not visible in any of the sections which the writer has examined. The failure of this zone to appear may be due to the thickness of the sections, but if so it would require unusually thin sections to show it. The intervention of the colorless, or third, zone between the dark first and fourth zones is a striking phenomenon and lends a high degree of probability to Borgström's view that the fourth zone is due to alteration of interstitial glass rather than to a penetration of molten matter from the surface. The thickness of the several layers, as observed by the writer, accords with that noted by Borgström, except in the maximum thicknesses which he quotes. The total crust on the small stone is rarely more than .3 mm. in thickness. Fragments of the meteorite heated B. B. turn black, shading to red distant from the flame and fuse on the edges to a black slag.

The meteorite as received at the Museum was penetrated by several small cracks extending in a general way at right angles to its broad surfaces. The courses of some of these can be seen in Plate V. Mr. Shie [illegible]s, finder of the meteorite, states that he noticed them the second day after digging the stone up. They probably indicate therefore a partial shattering of the meteorite due to its

impact upon the earth. Borgström has calculated from the depth of the hole which the meteorite made in the earth that the velocity with which it struck was one of 515 feet (157 m.) per second.* This is equal to the velocity which a body falling in a vacuum would acquire in 4600 feet.

The substance of the meteorite as a whole is fairly coherent, crumbling slightly under pressure by the fingers, but only slightly. It is sufficiently coherent to take a good polish. The specific gravity of the meteorite was determined in three ways, the determinations being made by Mr. H. W. Nichols. The first two determinations were made with a view to finding the apparent specific gravity, by which the porosity of the stone is shown. This determination was made in two ways. First, a cast of the meteorite was immersed in a vessel full of water, and the weight of the water thus displaced compared with that of the meteorite. This gave $G = 3.288$. For the second determination the volume of the meteorite was determined by comparing the weight of a cube of unit size made of the same plaster as the cast with the weight of the cast. The weight of an equal volume of water compared with the weight of the meteorite gave $G = 3.278$. The third determination was made by the ordinary method of comparing the weight of a piece of the meteorite immersed in water with the weight of the same in air. From a slab of the meteorite weighing 480 grams and partially bordered with crust, the specific gravity obtained by this method was $G = 3.504$. This corresponds almost exactly with the result obtained by Borgström, which was $G = 3.499$. Comparison of a mean of the two values for apparent specific gravity with the specific gravity as determined by the ordinary method, shows, using the formula given by King† the porosity of the meteorite to be 6.3 per cent.

The interior of the meteorite is in color light ash-gray, flecked with rusty-brown about the metallic grains, which are nickel-white to brass or bronze-yellow. Numerous circular spots of light and dark gray color indicate chondri. Those of dark gray are generally enstatite, those of light gray chrysolite. The diameter of the chondri sometimes reaches 6 mm. The metallic grains are for the most part rather uniform in size and distribution, appearing as metallic points scarce exceeding 1 mm. in any dimension. They may consist of nickel-iron alone, troilite alone or an aggregate of these. The two components may be readily distinguished by color.

* Op. cit. p. 75.
† Agricultural Physics p. 115.

In several instances a tendency to a ring-like form is observable, the diameters of such rings averaging about 2 mm. Aggregation of the metallic matter in the form of veins is also observable, and constitutes an essential feature of the meteorite. These veins appear in section as thin, irregular lines about .5 mm. in width, while their greatest extent in length noted was 5 inches (13 cm.). There are three such veins to be seen in the stone appearing entirely distinct from one another. In a general way they run parallel to the broad surfaces of the meteorite, although their course is tortuous and at times becomes somewhat diagonal to these surfaces. They outcrop on the crust surfaces of the meteorite as more or less continuous ridges rising .2 to .3 mm. above the surface. On the face shown to the left in Plate VIII two such outcrops can be seen nearly parallel with the front side of the meteorite. One of these is about half an inch (1 cm.) from the edge, and the other about one inch (2.5 cm.) below the first. As seen in section none of the metallic veins runs entirely through the body of the meteorite. In some sections they appear at the outer edges and disappear in the interior, while in others they appear in the interior but do not extend to the edges. This irregularity of course and extent tends, in the writer's opinion, to confirm his previously expressed view that such veins are phases of structure of the meteorite rather than filled fissures.* The general appearance of two of these veins in section, also the nature of the distribution of the metallic grains in general, is shown in the section represented in Plate XI. Over the triangular surface shown in the lower left hand corner of Plate V, where, as before remarked, a natural scaling along one of the veins has taken place, the substance of the vein could be examined. The appearance of the surface here exposed was one of uniformly bronze-yellow color, there being no differentiation of ingredients according to color. On removing a portion about 2 cm. square, however, and grinding it to a smooth surface, some of the metallic portions showed a nickel-white color while the rest remained bronze-yellow. This indicated that the vein was made up of aggregated nickel-iron and troilite, and this indication was confirmed by further tests. The nickel-iron grains, some of them several square millimeters in area, were subjected to the action of nitric acid in order to determine whether they showed Widmanstätten figures. None appeared, however, although several trials were made. The action of the acid only produced a minute pitting of the surface of the metal. By

*Am. Jour. Sci. 4, 11, pp. 60-62.

continued treatment with strong nitric acid the nickel-iron was entirely dissolved out and the troilite was left free. It was found to be chiefly in the form of small elongated and flattened nodules and plates, showing a tendency to faceting at some points, but with no determinable planes. One of these nodules had a length of 3 mm. The separation between these nodules and the nickel-iron seemed complete, there being no intimate intergrowth of the two substances. The troilite was of dark bronze-yellow color, non-magnetic and easily fusible to B. B. a magnetic globule.

The microscopic characters of the meteorite have been quite fully described by Borgström, and the features which he points out are essentially duplicated in the sections before the writer. The chondritic structure of the meteorite is very marked, and the chondri exhibit a variety of structures. Especially well represented are those made up of parallel lamellæ of chrysolite and glass. These lamellæ run in different directions in different chondri. In

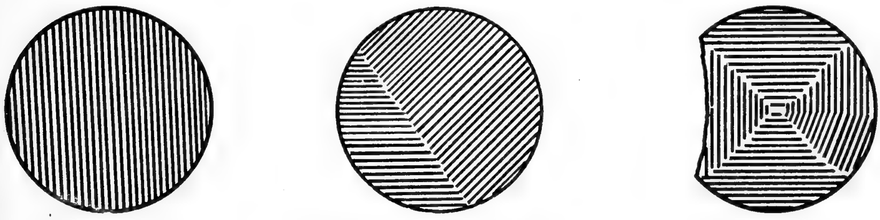


Fig. 2. Diagrammatic representation of arrangement of chrysolite lamellæ in chondri of Shelburne meteorite.

some they are all parallel and, together with the border of the chondrus, extinguish simultaneously. In others they may be found running in two or more directions, in which case those lamellæ which are parallel extinguish simultaneously, but extinctions are different for the different groups. In the accompanying diagrams, Fig. 2, are represented some of the arrangements of lamellæ observed. The first diagram shows a simple single arrangement, the second two sets of lamellæ meeting at angles of 135°, and the third practically two sets of lamellæ meeting at angles of 90°, although on one side the lamellæ are somewhat bent. Extinction in all these forms is parallel to the long axis of the lamellæ. The width of the lamellæ in the chondri of this character is remarkably uniform, and is about .01 mm. The diameter of the chondri themselves is from 1 to 1.5 mm. When the individual lamellæ are studied with a high magnifying power their apparent continuity in the direction of length resolves itself into two

or more component lamellæ joined end to end. The ends of these component lamellæ are usually rounded. The lamellæ are frequently crossed by fractures which usually run normal to the length, but are occasionally more inclined.

Between chondri with a structure of the above character and those which are porphyritic there seem to be all gradations. The stages are: 1. Chondri in which the lamellæ are wider and fewer in number; and 2. Wide lamellæ extending only partially across the chondrus. If the writer is correct in this observation, it is easy to see that differences of extinction do not necessarily prove a polysomatic origin for a chondrus. The lamellæ of each chondrus of the types figured above are doubtless of a single generation, though differently oriented. So the crystals of a single chondrus though differently oriented may be of a single generation. Another arrangement of chrysolite and glass lamellæ which was seen in addition to those noted above was an eccentrically radial one. These lamellæ are wider than those which are parallel. In this case the lamellæ are wedge-shaped, and are enclosed in a glass so dark as to be opaque. In the porphyritic chrysolite chondri the crystals were for the most part uniform in size. In one chondrus, however, a large crystal with rectangular outline was seen to occupy the center with smaller ones grouped concentrically about it. In another large chondrus a smaller one was enclosed. In addition to its occurrence in chondri chrysolite is to be found in individual crystals scattered through the mass of the meteorite. These crystals usually do not appear to be formed in place, but to be fragments consolidated with the chondri. They show no signs of decomposition or wear, and are free from inclusions. In outline they are rectangular to polygonal, and in length measure from .2 to .5 mm.

The enstatite chondri show little variation from the usual fan-shaped forms. The individual fibers in these forms, however, are usually much less distinct than the individual lamellæ of the chrysolite chondri. In one enstatite chondrus an appearance of a system of fibers crossing the main system at right angles was found on study with a higher power to be due to a textural change across the fibers along these lines. Such a change suggests strain. Large individual crystals of enstatite occur, the largest noted being lath-shaped and having a length of 4 mm. and a width of 2 mm. This is truly a remarkable size when compared with that of the general constituents of the meteorite. The outlines of this crystal were irregular, yet it was sharply separated from the surround-

ing field. Its interior was somewhat corroded and honeycombed, from what cause does not appear. It showed cleavage in two directions to which extinction was parallel.

In connection with the occurrence of troilite in the meteorite, it may be noted that one chrysolite chondrus showed grains of troilite, scattered about its periphery and a vein of the same mineral extending diametrically across it.

Acknowledgments are due Dr. C. A. Chant, of the University of Toronto, and the late Arthur Harvey, Esq., of Toronto, for information kindly given regarding the meteorite.

THE SOUTH BEND METEORITE.

BY OLIVER CUMMINGS FARRINGTON.

This meteorite was found in the spring of 1893 on a farm about two miles southeast of the city of South Bend, St. Joseph County, Indiana. The location of the point of find is 86° 15′ W. and 41° 38′ N. The township in which the find was made is not Portage township, in which South Bend is located, but the next one east, Penn township. On account, however, of the close proximity to the well-known city of South Bend it seems advisable to call the meteorite by this name. The place of find was a slope of one of the morainic hills which characterize the area, and the meteorite was discovered when plowing the soil. It attracted attention as a curious stone and was therefore thrown upon a pile with other curious stones, there to lie until its meteoric nature was detected in the fall of 1904 by Mr. George A. Baker of South Bend, Secretary of the Northern Indiana Historical Society. From Mr. Baker the entire mass was obtained for the Museum. Its weight when obtained was 5½ pounds (2,374 grams).

The meteorite is seen at a glance to be made up chiefly of iron and chrysolite, and to be therefore a pallasite.

The shape of the mass may be approximately described as like that of a baby's shoe. This resemblance is perhaps best shown by the side view given in Plate XIII. The leg of the shoe, however does not widen toward the top, but narrows and shows a slight twist. Following the simile the dimensions of the meteorite may be given as follows: Length (along sole of shoe), 5½ inches (14 cm.); height (from heel to top of leg of shoe), 5 inches (13 cm); width (of sole of shoe), 3½ inches (9 cm.); circumference (around sole of shoe), 15 inches (38 cm.); circumference in direction at right angles to above), 12 inches (31 cm.). The appearance of the meteorite from the side described as the sole of the shoe is shown in Plate XV, and that from the rear of the shoe, showing the curving of the upper portion, in Plate XVI.

As all the plates show, the surface of the meteorite is everywhere deeply pitted, giving the entire mass a porous appearance. The

pits in general have rounded outlines, and are about half as deep as broad. A diameter of about half an inch (1 cm.) is common, but occasionally a breadth of one and a half inches (4 cm.) is reached. At one point the bottoms of two pits on opposite sides meet and produce the perforation shown in Plate XIV. This perforation is about one-fourth of an inch (5 mm.) in diameter. Another pit above this point produces a similar though smaller perforation. A broader, shallow concavity with subordinate pits occurs upon this same surface. The diameter of the outer rim of this concavity is about three inches (8 cm.). The other broad surfaces of the meteorite tend to be plane or convex. In addition to the pits, which are confluent at their bases, there are many confluent at their sides, producing irregular, sinuous depressions all over the surface of the meteorite. While these cavities are referred to as pits they should probably not be regarded as due to the aërial course of the meteorite. On the contrary they are altogether produced, so far as can be judged, by the weathering out of chrysolite from the metallic matrix. That they indicate cavities previously occupied by chrysolite is shown partly by the spheroidal shape of the pits and partly by the remains of chrysolite in some of the pits. The edges of the pits are for the most part rounded so as not to leave sharp, projecting points. Such roundings may well have been caused by fusion during the passage of the mass through the atmosphere. Although the substance of the meteorite is tough and firm as a whole the surface is considerably rusted and the pits filled to some extent with sand cemented with iron hydroxide. This indicates that the meteorite has been exposed for some years to the elements, but not many, for a moist climate, such as prevails in the region where it was found, would cause rather rapid decomposition. The coating of rust on the projecting ridges and points of the meteorite or in the pits not filled with sand is very thin, a single scratch with a file serving to reveal bright metal beneath. This rust is dark brown in color. Where the pits are filled with cemented sand the color becomes a yellowish-brown. There is no indication in the contour of the mass of its having been subjected to movement and pressure, such as it would have undergone had it been glacially transported. The indications are, therefore, that the mass fell not many years ago near where it was found.

The specific gravity of the meteorite was determined by weighing carefully the entire mass, first in air and then in water. This gave the value $G = 4.28$. Assuming the specific gravity of chrysolite

to be 3.35 and that of nickel-iron to be 7.70, the ratio of chrysolite to nickel-iron by weight in the meteorite indicated by this specific gravity is:—

Chrysolite..	78.63
Nickel-iron..	21.37
	100.00

This result is necessarily too high for the chrysolite and too low for the nickel-iron as regards the original constitution of the mass, on account of the fact that some of the original nickel-iron has altered to limonite, and some of the pores contain more or less sand. What change should be made in the above figures on this account in order to express the actual original composition of the meteorite, however, it is impossible to determine, but it is hardly likely that a change greater than 5 % should be made.

A piece of the meteorite weighing about 220 grams was removed by sawing, giving a section having a surface about 2 inches square available for study. The appearance of this section is shown in Plate XVII. As indicated by the external characters, the interior of the mass proves to be a sponge-like body of nickel-iron, the pores of which are filled with chrysolite. The shape of the pores tends to be rounded or polygonal, but is occasionally elongated or quite irregular. A diameter of about half an inch (12 mm.) is a common one for the pores, and they rarely exceed this. The distribution of the nickel-iron is rather uniformly tenuous but occasionally bunched so as to give a square centimeter of surface without chrysolite. The walls of the pores as seen after removal of the chrysolite are sinuous rather than angular and have smooth surfaces. A black graphitic layer about .1 mm. in thickness usually lines the pores, separating the nickel-iron from the chrysolite. A similar layer occurring in the Mount Vernon meteorite has been described by Tassin.* Etching brings out well-defined figures on the nickel-iron showing that it is made up of the usual alloys of kamacite, tænite and plessite. The kamacite bands are swollen and very variable in width, but rarely exceed 2 mm. in this direction. For the most part the bands tend to border the chrysolite blebs, following their outlines in varying course. Bordering the kamacite on the side opposite the chrysolite occurs a thin ribbon of tænite appearing and disappearing without regularity, but for the most part quite constant. The plessite, dark gray in color, fills the spaces between the kamacite bands, resembling in its irregular shapes the hieroglyphic figures assumed by schreibersite in some of the ataxites. At times its

*Proc. U. S. Nat. Museum, 1905, vol. xxxiii, p. 216.

structure is comb-like on account of alternating filaments of tænite, but for the most part it is uniform and homogeneous. The nickel-iron is malleable but hard.

An analysis of the nickel-iron made by Mr. H. W. Nichols gave the following results :

Fe	=	90.22
Ni	=	9.35
Co	=	0.26
Cu	=	0.11
P	=	0.05
S	=	0.05
		100.04

Schreibersite forms an accessory constituent of the meteorite, distinguishable from the nickel-iron by its tin-white color and granular surface. At one point in the section examined it is seen uninterruptedly over an area about 4 mm. square. At another point it forms a part of the wall of one of the pores, separating two chrysolite blebs by a space of about 1 mm. Again it fills about one-fourth part of a pore, the rest of the filling being chrysolite. The occurrence of the schreibersite seems to be independent of the nickel-iron, no swathing kamacite surrounding it. It is brittle, magnetic, and gives the test for phosphorus with ammonium molybdate.

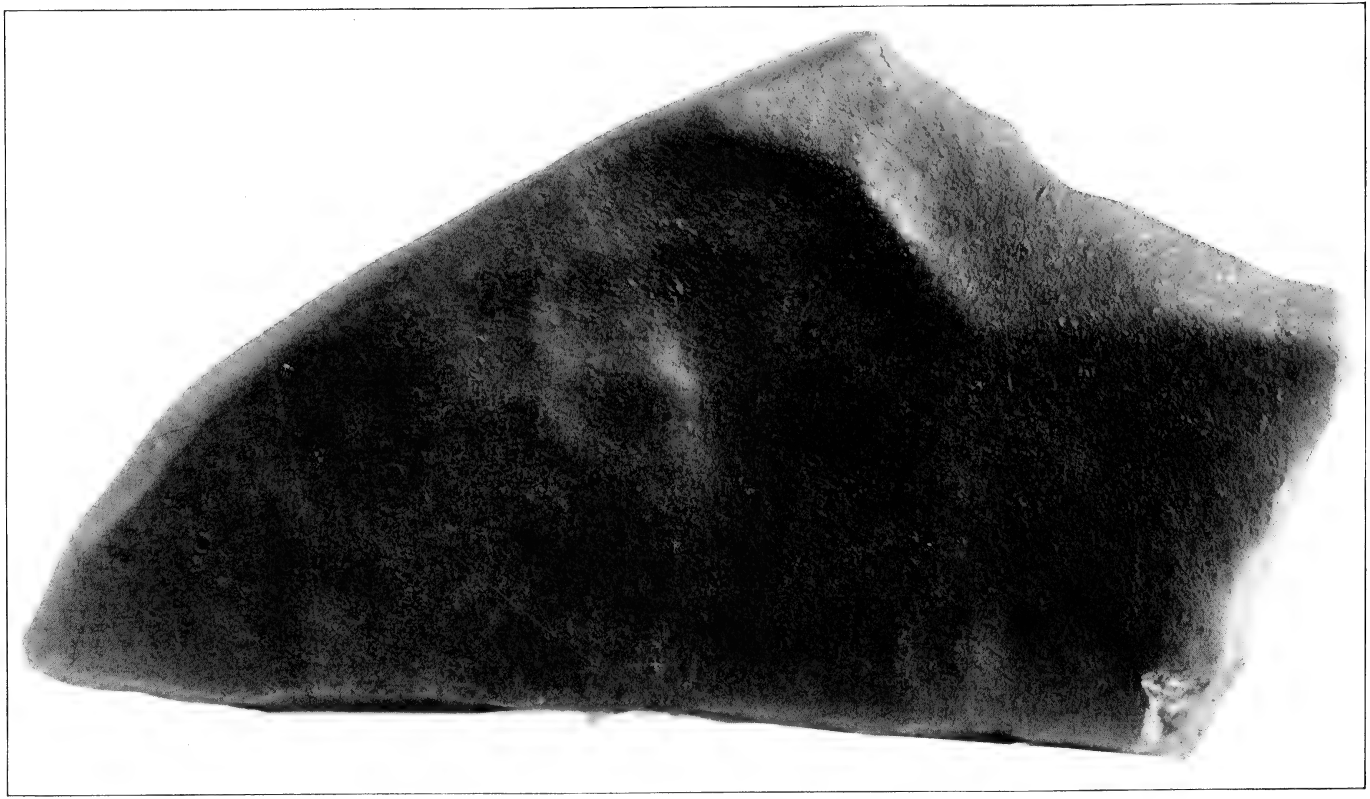
The chrysolite of the meteorite occurs, as previously stated, filling the pores of the nickel-iron. In spite of the smoothness of the walls of the pores the chrysolite adheres firmly to them so as to be removed only with difficulty. The surface of the blebs is usually rounded and none showed angular facets suitable for measurement. The color of the chrysolite is generally dark brown to black, though occasionally a typical olivine green. Often there are variations of color in the same bleb. As a rule, the color is lighter toward the center and grows gradually darker toward the periphery, but occasionally there are sectors sharply separated by being darker or lighter than the remainder of the bleb. Though the blebs generally appear opaque when seen as a whole, fragments the size of a pin-head or larger are usually transparent. Under the microscope such fragments appear clear except for opaque brown or black layers scattered through them. The fragments are often magnetic before heating and always so after heating. The individual blebs are monosomatic as shown by the uniform directions of their cleavages and lack of zonal structure. They are considerably fissured and broken, but not as much so as in the Imilac chrysolite.

South Bend is the seventh pallasite to be discovered in the United States, the others recognized being Admire, Anderson, Brenham, Eagle Station, Mount Vernon and Port Orford. Of these Anderson is the nearest in locality to South Bend, but it is one hundred and fifty miles distant. In structure, moreover, it differs. In the character of its etching figures and the fissured state of its chrysolite, South Bend resembles the Imilac pallasite more than that of Krasnojarsk. It therefore belongs to the Imilac group, and is the first representative of this group to be found in the United States. To the meteorites of Indiana it adds a sixth, those now known from the State being as follows :

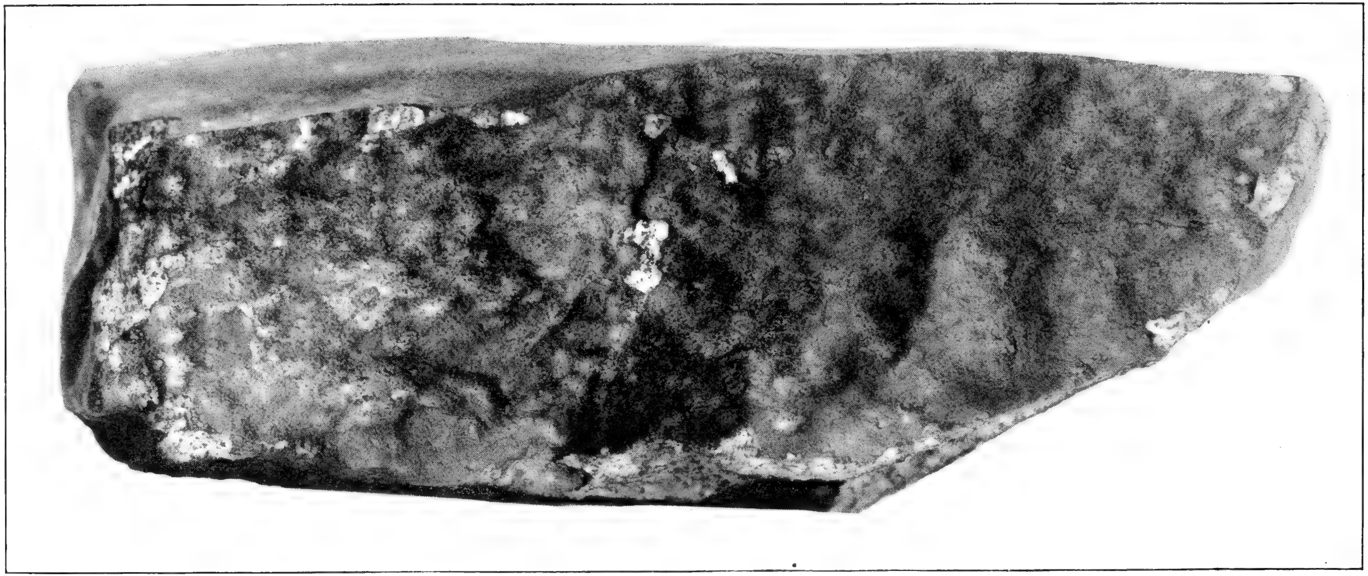
Harrison County,	Stone	Cho.	Fell March 28, 1859.
Kokomo,	Iron	Dc.	Found 1862.
Plymouth,	Iron	Om.	Found 1893.
Rochester,	Stone	Cc.	Fell Dec. 21, 1876.
Rushville,	Stone	Cg.	Found 1866
South Bend,	Iron-stone	Pi.	Found 1893

The locations of the points of fall of the above meteorites are shown on the accompanying map of Indiana, Plate XVIII. A noticeable feature of the distribution of these falls is that all but one are along a north and south line close to the meridian of 86°. The three falls known in Michigan, viz : Allegan, Grand Rapids and Reed City, also follow closely the same meridian.

Shelburne meteorite. Front side, × $^7/_{10}$.

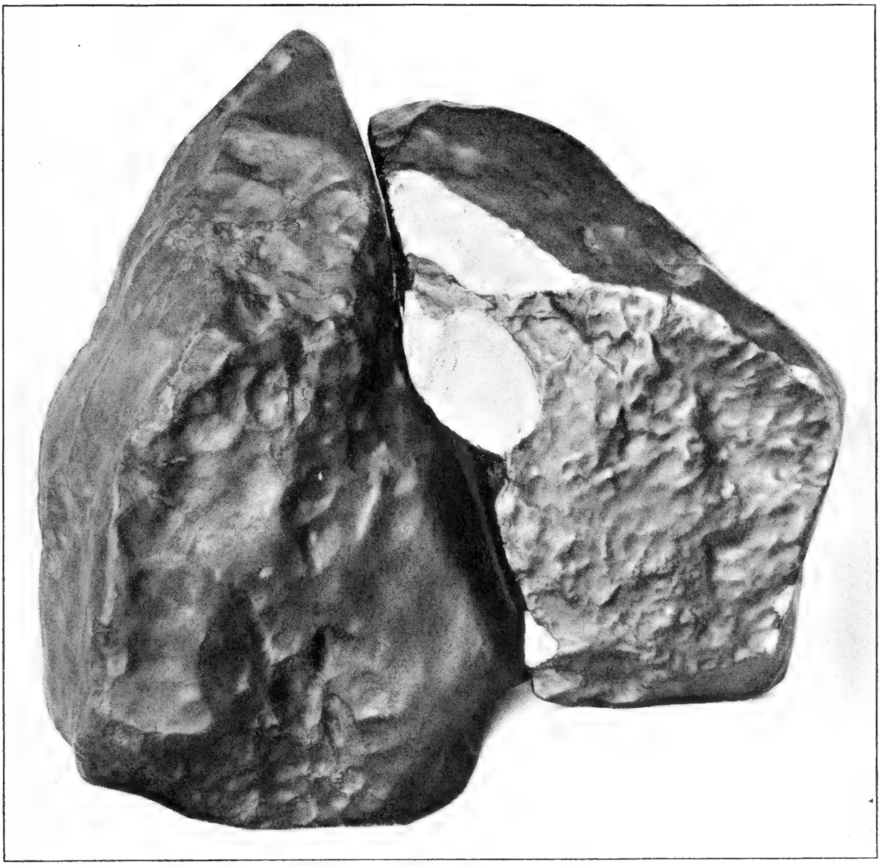


Shelburne meteorite. Rear side, × 7/10.

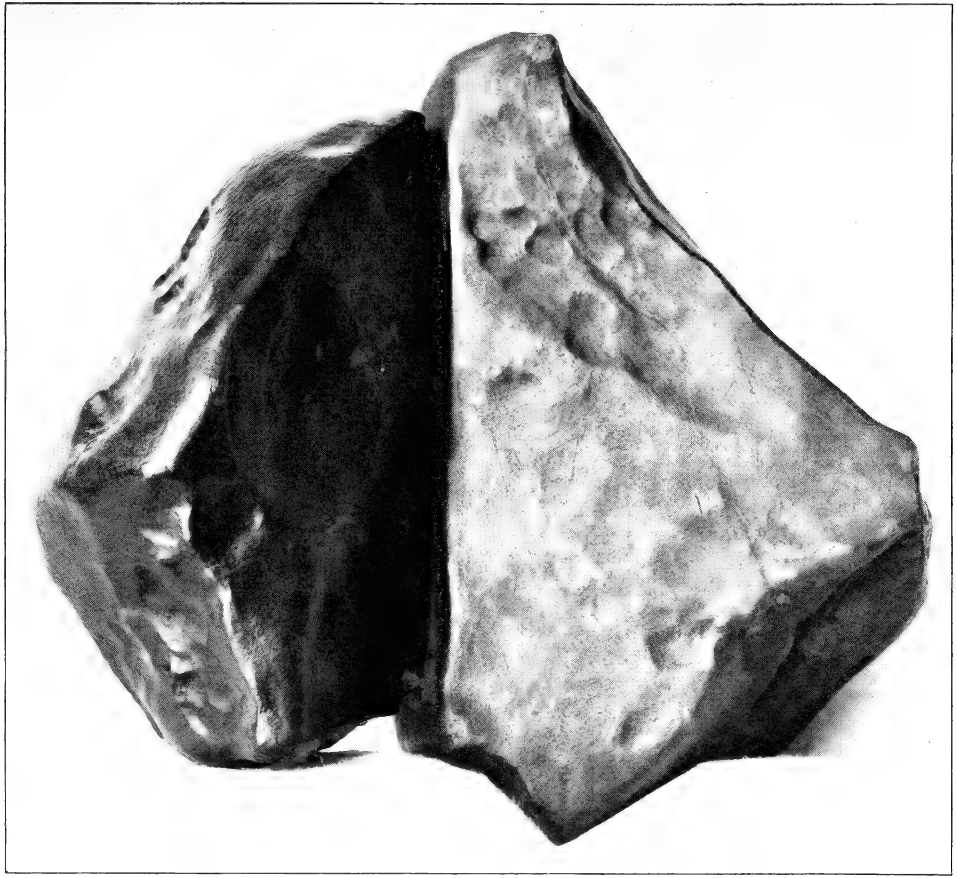


Shelburne meteorite, showing secondary crust and drift phenomena, $\times$ 7/9.

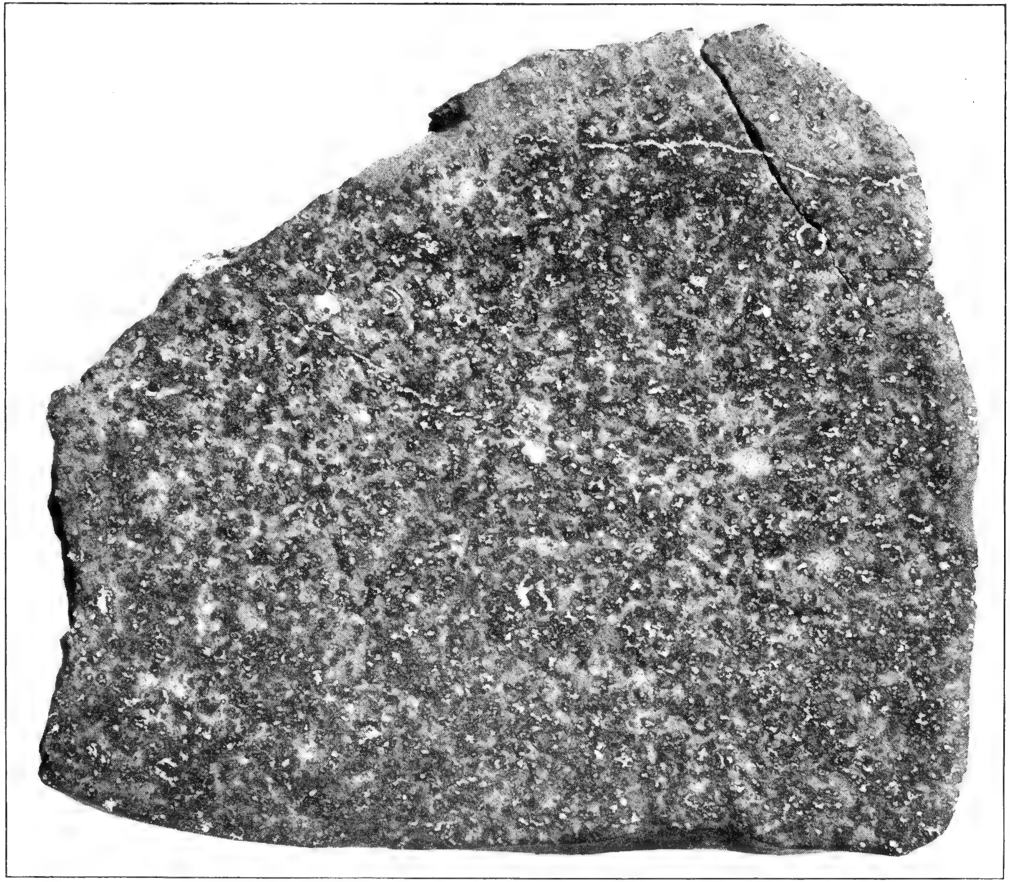
Shelburne meteorite. Side view, × 7/10.



Shelburne meteorite, showing form produced by joining the two stones together. Front side, × 2/5.

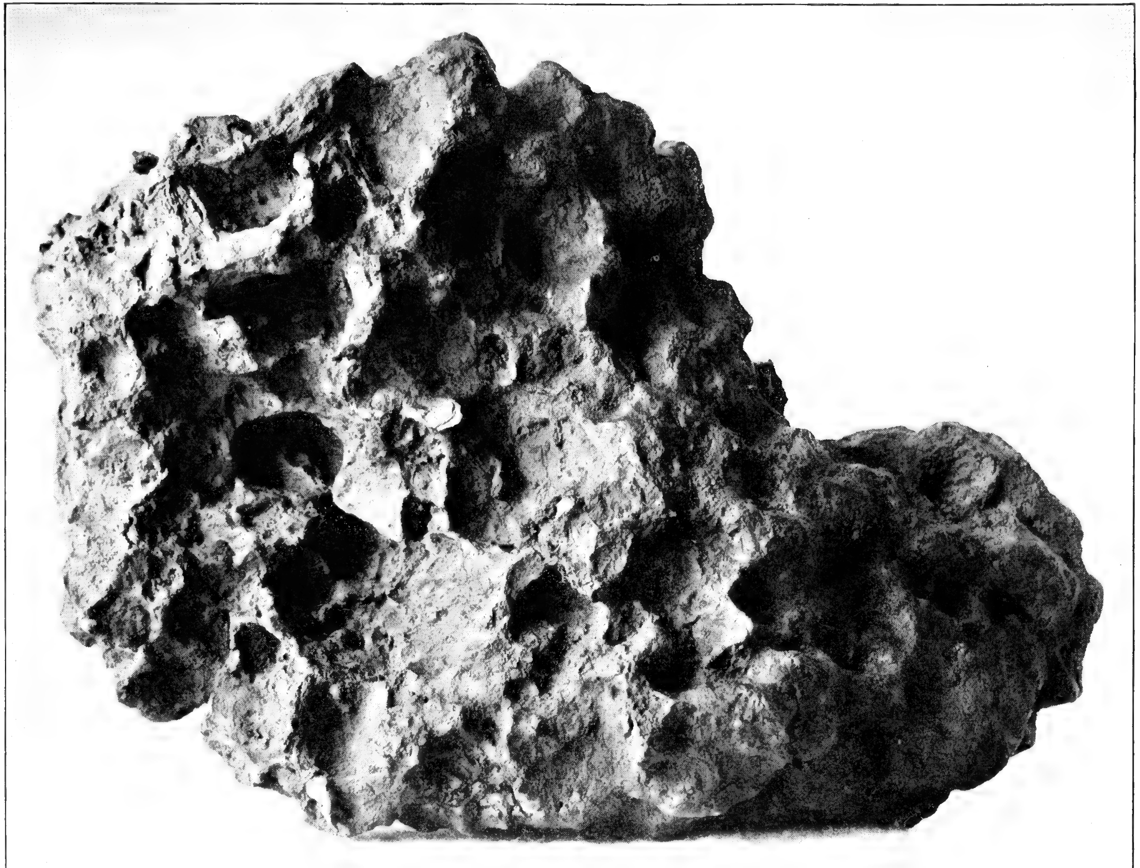


Shelburne meteorite, showing form produced by joining the two stones together. Rear side, $\times \frac{2}{3}$.

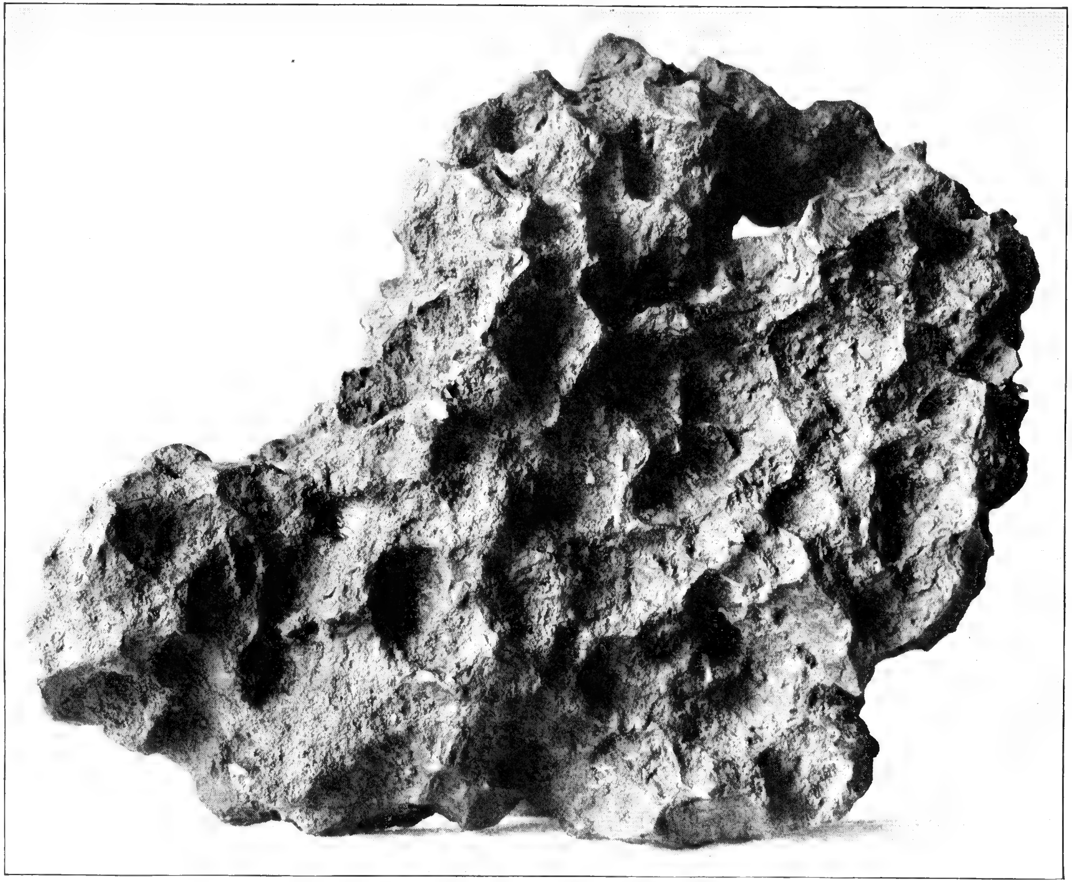


Section of Shelburne meteorite, showing metallic veins and distribution of metallic grains, × 4/3.

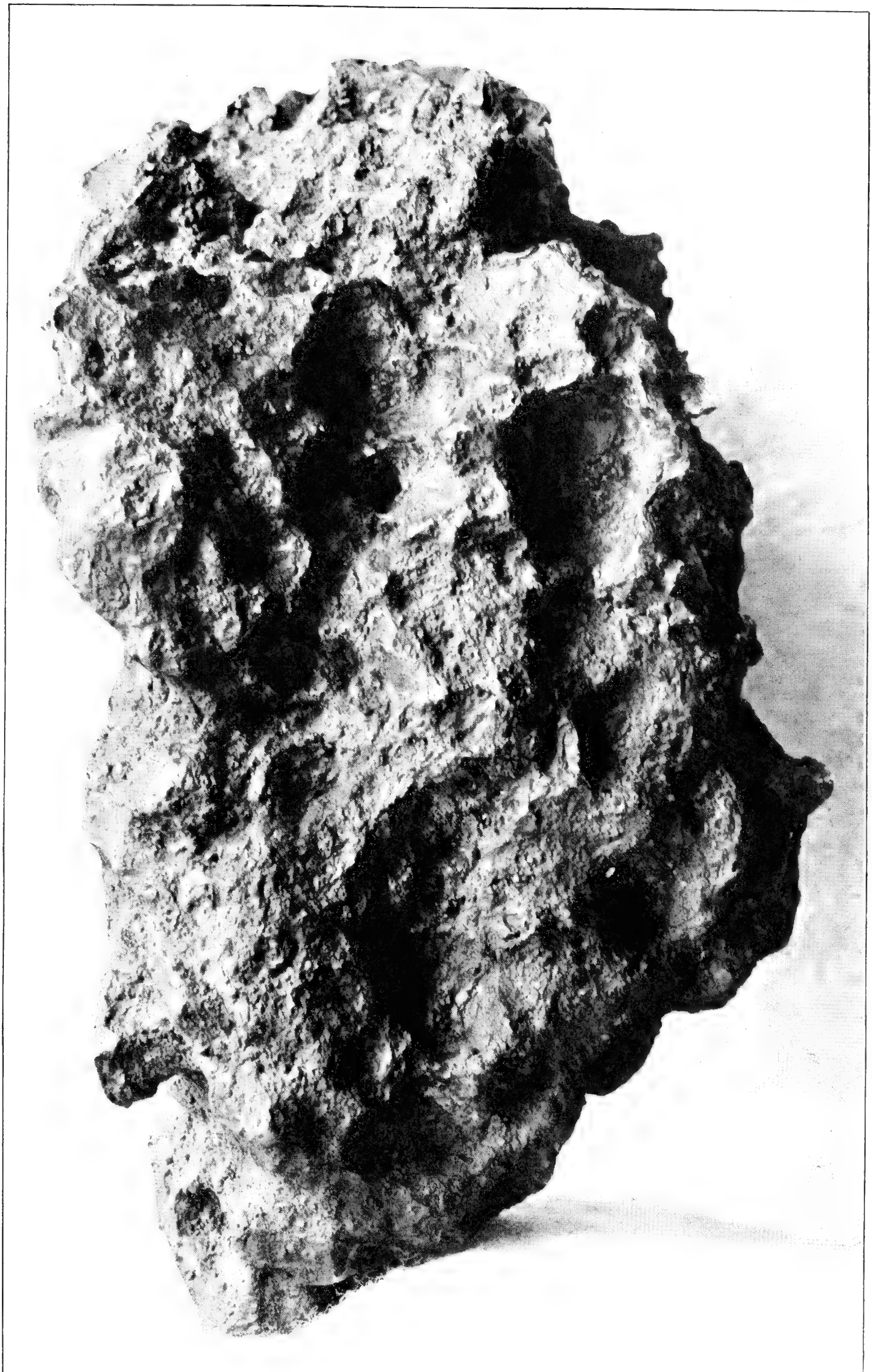
Map of Ontario, showing location of known meteorite falls.



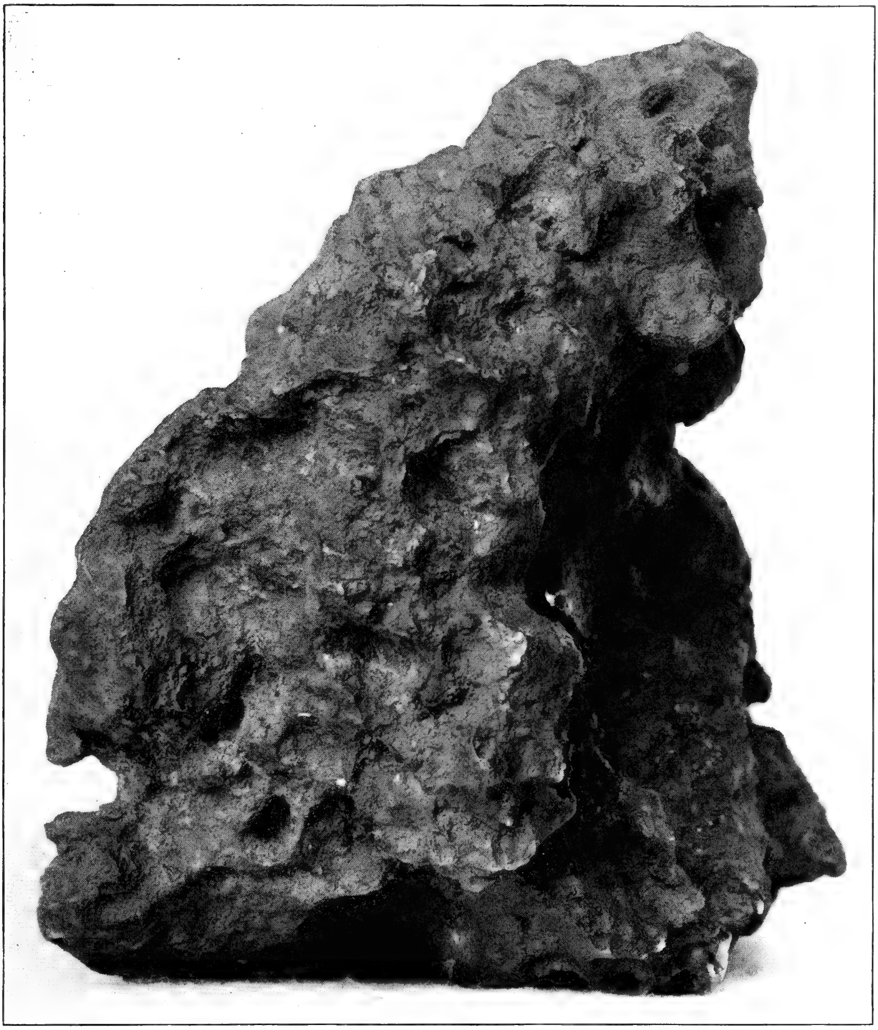
South Bend meteorite. Side view, $\times$ 1.



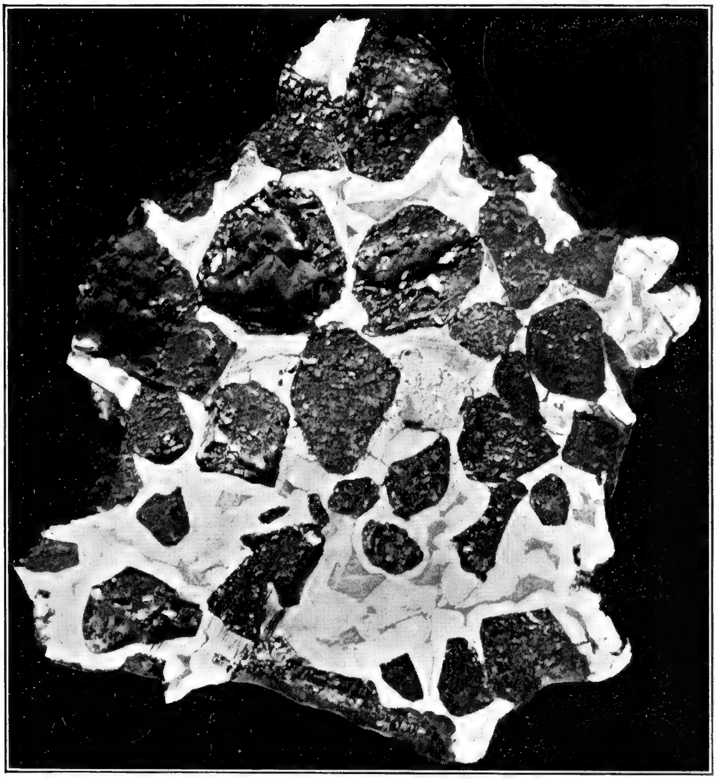
South Bend meteorite. Side view, showing perforation, × 1.



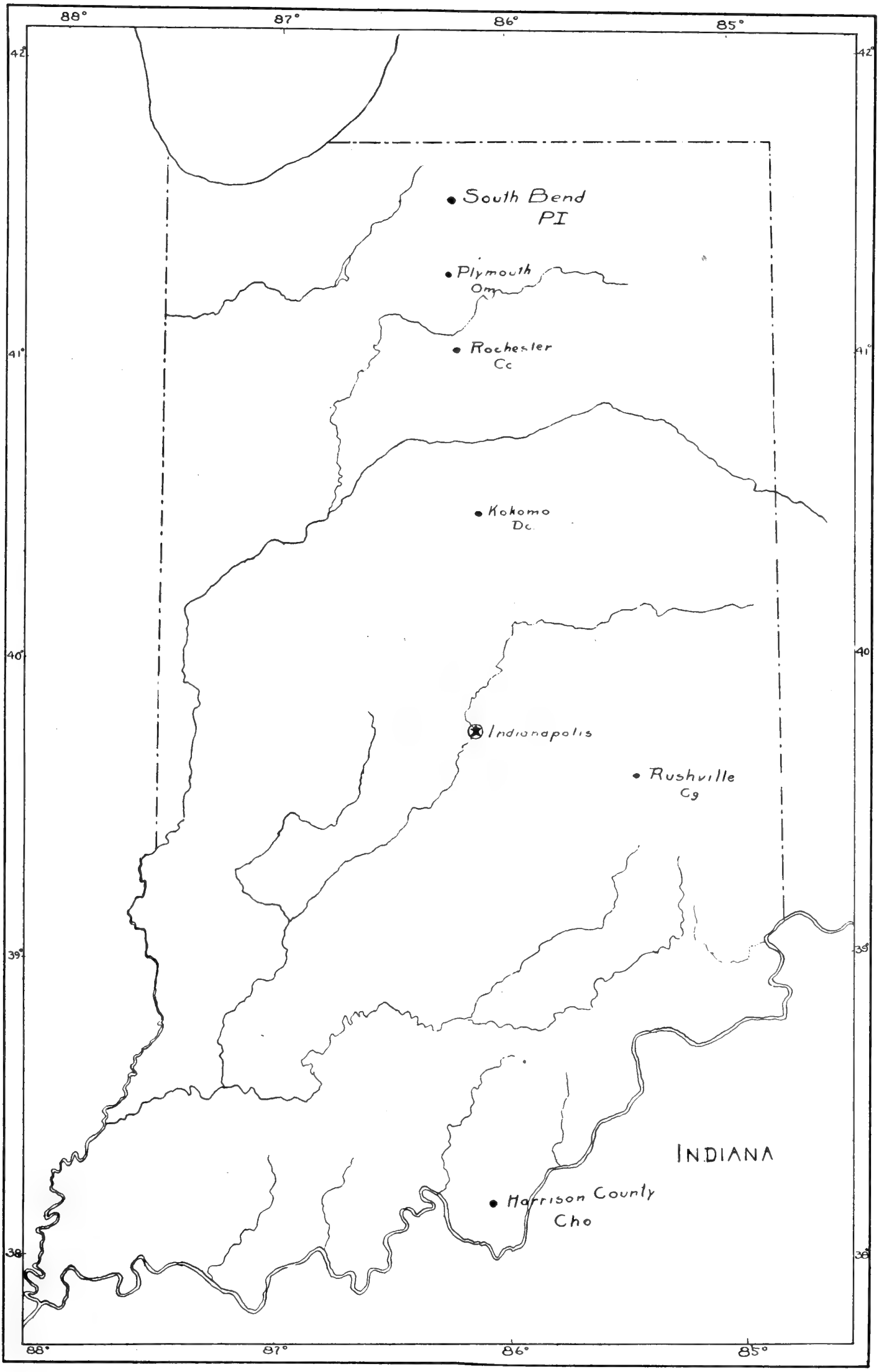
South Bend meteorite. View of base, × 7/5.



South Bend meteorite. End view, × 7/5.



Etched section of South Bend meteorite, showing arrangement of nickel-iron and chrysolite. The light portions are nickel-iron, the dark chrysolite, $\times \frac{8}{5}$.



Map of Indiana, showing location of known meteorite falls.

NEW FORMS OF CONCRETIONS

By HENRY WINDSOR NICHOLS

SAND-CALCITE CONCRETIONS FROM SALTON, CALIFORNIA

A series of five sand-calcite concretions (Museum No. G, 1301) presented to the Museum by Mr. Herbert Brown of Yuma, Arizona, appear worthy of description. Regarding the conditions of the occurrence of these concretions little is known. Mr. Brown simply states that they were handed him by a commercial traveler as having been obtained by him at Salton, California. As there are extremely large sand dunes in the immediate vicinity of Salton, it is probable that the concretions were formed in these. Whether or not the form represented by the specimens at hand is a common or an unusual type in that locality is unknown. These concretions (Plate XIX) are formed of sand cemented by calcite, and are, therefore, of the type of the well known Fontainebleau and Saratoga Springs concretions, from which, however, they differ in several respects. The Salton concretions take the form of an irregularly botryoidal ball from which projects a stout, tapering stem in such wise that the object assumes the shape and proportions of an ancient mace. The change from head to stem is abrupt, much as if the stem were driven into a hole bored in the head, and there is even a slight annular depression in the latter where the stem enters. The botryoidal appearance of the head is due to a compound structure — each head being built up from a number of spheroidal concretions grown together. While there is but little flattening of the concretion as a whole, the subordinate spheroids are much flattened and also elongated in the line of the principal axis of the concretion. The specimens have a very rough surface from the presence in large numbers of rhombohedral points of arenaceous calcite crystals. These points suggest that these concretions, like those from Devil Hill, Wyoming, described by Barbour,* are aggregates of moderately large crystals. Lines of stratification (PlateXIX) intersect the specimens in such a direction as to ind cate that the principal axes lie conformably with the strata in which they form.

* Bull. Geol. Soc. Amer., Vol. XII, p. 165.

The slight flattening of the complete individual as well as the greater flattening of the subordinate spheroids of the head is in the plane of bedding of the surrounding sand.

The specimens in the possession of the Museum weigh from 45 to 952 grams. The diameter of the ball lies between 30 and 70 millimeters, and that of the thickest part of the stem between 20 and 30 millimeters. The head of the concretion, therefore, varies much more in size than the stem. The stems, however, are very variable in length; the shortest is 55 and the longest 210 millimeters. Two of the specimens are compound, consisting respectively of two and three individuals grown together.

The specific gravity of the concretions is 2.69, and they are therefore a little denser than the average concretion of this character. Concretions of sand and calcite from Saratoga Springs in the Museum collections have a density of 2.62; those from Fontainebleau of 2.42. The sand-calcite concretions and crystals from Devil Hill, Wyoming, which have been studied by Barbour,* have a specific gravity, as determined by the present writer, of 2.64. According to Dana, the Fontainebleau crystals vary in specific gravity from 2.53 to 2.84.† The great variation in these figures is, however, not to be taken as indicating corresponding variations in the true density of the objects. They rather indicate differences in the methods employed by various experimenters and differences in the shape and size of the pores of different specimens. It is evident that the true specific gravity of a mixture of calcite and quartz cannot be less than 2.65, the specific gravity of the lighter constituent. The very great influence of the character of the pores and of the shape and size of permeable objects of the character of those under consideration are discussed in this paper, page 50. For the reasons there given, the specific gravities of the Salton, Fontainebleau, and Saratoga Springs specimens, determined at the Museum, are probably low, but it is believed only slightly so.

The carbonate cement of the Salton concretions is soluble rapidly and with brisk effervescence in cold dilute hydrochloric acid, and is therefore essentially calcite. The dissolved cement, however, yields noticeable quantities of iron to chemical tests.

The sand of the Salton concretions, when cleansed by cold dilute hydrochloric acid, is of a light gray color, subangular, and very fine. It all passes a 60 mesh sieve, 17% is retained upon an 80 mesh, 48% additional upon 100 mesh, and 35% passes through a sieve of 100

* Bull. Geol. Soc. Am., Vol. XII, p. 165.

† Dana: System of Mineralogy, p. 266.

meshes to the inch. It appears that the closeness with which the sand packs itself has some bearing upon the nature of the concretion. A sand of similar physical constitution was prepared from a mixture of glass sands by the use of sieves. This sand was packed into a glass cylinder and compacted by long tapping of the outside of the cylinder by a stout wooden rod. This sand, so compacted, enclosed between its grains 40% of voids which were calculated by the usual formula.*

Such a sand undisturbed in its natural bed may be assumed to compact itself in time somewhat more than it may be compacted by a few minutes' tapping in the laboratory. Such undisturbed sand beds, according to King and others,† contain 35% to 40% of pore space. Therefore if a sand-calcite concretion is composed of calcite filling voids previously existent between grains of sand, it will have by volume a composition of calcite 35–40%, silica 65–60%. The composition by weight will be approximately the same, as the specific gravities of the minerals differ but little. Such a composition has in fact been proved by the only two determinations of this character known to the author for similar concretions. These were carried out upon material from the two widely separated localities Devil Hill, Wyoming,‡ and Fontainebleau, France.§

A determination of the percentage of sand and calcite in the Salton concretions was made upon material broken from the stem. The fragments were treated with cold dilute hydrochloric acid and the insoluble sand weighed. The concretion was found to contain: sand, 29.17%; calcite, 70.83%. This corresponds to a composition by volume of about: calcite, 70%; sand, 30%. The above facts may be tabulated as follows:

COMPOSITION BY VOLUME OF SAND-CALCITE CONCRETIONS FROM THREE LOCALITIES:

	Sand, %	Calcite, %
Theory	65 – 60	35 – 40
Devil Hill	64	36
Fontainebleau	50 – 63	50 – 37
Salton	30	70

From this table it appears that in the Fontainebleau and Devil Hill concretions the calcite is little, if any, in excess of that required to fill the voids between the sand grains. The Salton concretions, on the other hand, have but half the sand and twice the calcite required for

* King: Physics of Agriculture, p. 115.
† Ibid.: p. 126; Warington: Physical Properties of Soil, p. 66.
‡ Barbour: Bull. Geol. Soc. Am., Vol. XII, p. 165.
§ Dana: System of Mineralogy, 6th ed., p. 266.

such a constitution. There are four hypotheses which may account for this excess of calcite: 1. The concretion may have formed in a partially opened crevice; 2. Part of the calcite may be fragmental; 3. Part of the sand may be impregnated with or replaced by calcite; 4. The calcite when crystallizing may have exerted pressure upon the sand grains and moved them apart.

The first hypothesis, a partially opened fissure, is practically negatived by many conditions and may be dismissed at once. Between the other three, microscopic study might discriminate. A slide was therefore prepared for this purpose, from a cross section of the stem of a concretion. The sand grains in this slide proved to be of the usual character of those sands which are derived from acid crystalline rocks. The great majority of the grains were quartz. Partially kaolinized feldspars were present in some quantity, also scattered fragments of biotite, muscovite, dark amphiboles, and a few grains of minerals not readily recognized. Such minerals as garnet, ilmenite, magnetite, etc., were completely absent. The grains varied from angular to well-rounded, but the greater portion were of a sub-angular character. With the exception of the slight kaolinization of the eldspars the minerals of the sand grains were wholly unaltered. The calcite proved to be wholly in the cement, and the cement contained no other mineral than calcite. No alteration of the calcite was observed, nor any calcite of fragmental origin, nor did any of it replace sand. The calcite was found to occupy more than half the area of the slide, the grains of sand seldom touched, but were separated by bands of calcite cement, which varied greatly in width. These calcite bands were frequently much wider than the diameter of the enclosed grains. It appears, therefore, that the calcite in crystallizing has exerted sufficient pressure to push apart the sand fragments, although no anomalous optical features were noted indicating strain in the cement. The cement was in the form of calcite crystals of cross sections comparable in magnitude with those of the sand grains. While many of them lay in parallel positions, sufficient data could not be secured from a study of the slide to determine whether or not the calcite is in the form of radiating crystals or of other regular or irregular aggregates.

The concretions in the Museum collections which possess a character most resembling the Salton forms in shape and appearance are from the two well-known localities: the Paris Basin, and Saratoga Springs, New York. The specimen from the Paris Basin which appears to possess the most in common with the Salton concretions

is a chain of four sand-calcite balls from Clermont. (Plate XX, Fig. 1.) This consists of four spheres between 140 and 160 millimeters in diameter united into a slightly curved chain 49 centimeters long. The spheres where they join interpenetrate for perhaps one-eighth to one-twentieth of their respective diameters. Each ball s nearly spherical with no marked flattening and is simple. The only complication of form is an abrupt change in diameter of the spheres giving each the external form of a laminated body from which the external shell has been half broken away. This is, however, a consequence of differing rate of growth for different sides of the sphere and is in no wise dependent upon internal structure. These deposits, which are associated with mineral springs, are doubtless more or less tufaceous in character.

The sand-calcite concretions of Saratoga Springs, New York, tend to form sheets by the coalescence of many ind.viduals and thus much of the material is better described as sandy calcareous tufa than as concretionary. The two specimens shown in Plate XXI illustrate this phase. These are respectively 15 x 40 and 17 x 20 centimeters in area and both are from 3 to 6 centimeters thick. Both specimens are fragments evidently broken from considerably larger sheets. The individual concretions from these sheets are forms modified from the sphere by agencies which have p oduced a flattening and elongation, so that the simplest form of common occurrence is a somewhat flattened ovoid or pear (Plate XXI, Fig. 1) with the same appearance of lamination which occurs upon the Paris Basin specimens. The larger number of those concretions which unite to form a sheet of tufa at Saratoga Springs are much more elongated than these pear shapes. Many of these more elongated forms so coalesce as to lose their identity and present merely a solid, wavy surface. When the individuality is not so completely lost, there arise, first, shapes resembling a long-necked gourd, then, as the elongation becomes greater, the flattening becomes greater also, the form becomes wavy in both the horizontal and vertical planes and deep, strong, longitudinal and occasionally transverse striations appear. Thus the elongated individuals forming these sheet-like bodies of concretion tend to become flat and more or less curved.

Besides the tufaceous sheets, separate individual concretions are common among the Saratoga Springs material. These show little or no flattening and sometimes but little departure of any kind from a spherical form. They are frequently heavily striated in a meridional direction by deep grooves which come together at two

poles. When compounded, they assume grotesque and imitative forms. The nearest approach to the Salton forms is a double concretion from Saratoga Springs (Plate XX, Fig. 2). This consists of two cones with hemispherical bases. They are similar in form but differ in size. The apex of the smaller is united with the base of the larger. The length of the specimen is 38 centimeters and its greatest diameter 8 centimeters. This may be considered as two independent concretions which have grown together, and the larger cone alone may be compared with the California specimens. This larger cone is as smooth on the surface as the sand which enters into its composition will permit. It is slightly curved. There is the usual fold-like longitudinal swelling where it has grown faster in one direction than another. The cone tapers gradually with no abrupt change of curve from the widest portion to the apex. The relation between the specimens from Salton and those from Saratoga Springs and the Paris Basin are best brought out in tabular form:

COMPARISON BETWEEN SAND-CALCITE CONCRETIONS FROM THREE LOCALITIES:

	Salton.	Saratoga and the Paris Basin.
Surface:	Roughened with rhombohedral points. Never striated.	Smooth. Often striated.
Spherical forms:	Compound. Oblate.	Simple. Prolate or ovoid. Pseudo-concentric.
Elongated forms.	Circular section. Straight.	Flattened section. Curved or wavy.
Junction of spherical to elongated form.	Abrupt.	Always gradual.

Lack of data prevents discussion of the nature or origin of these concretions from Salton, California. There is, however, one suggestion which is called forth by the shape of these objects when they are compared with some hitherto unrecorded forms of concretions of an entirely different character. The stem of any one of these California specimens is very like a stalactite depending from the head.

In certain sand dunes, notably in the "Hoosier Slide" of Michigan City, Indiana, flat sheet-like bodies of limonite concretion form in certain strata of the sand. When these are dug out, numerous small stalactites of limonite are found depending from their lower surfaces.

These stalactites are, however, too friable to be preserved. These limonite concretions form by deposition from a sheet of ferriferous water which flows during wet weather along a more permeable layer of dune sand or upon the surface of a comparatively close-packed and impervious stratum. It is evident that this comparatively impermeable layer is able to form in wet weather some fashion of floor for the stream of iron-bearing waters. This floor is, however, but imperfect and very leaky, so that the limonite stalactites have ample opportunity to form where the water drips through. It is very possible that in the case of these sand-calcite concretions some similar structure of the dunes near Salton has permitted a similar stalactite to form at the base of such concretions as were favorably placed.

SAND-BARITE CRYSTALS FROM OKLAHOMA

These specimens (Museum No. G. 1285, Plate XXII) were collected by Prof. Charles N. Gould of the University of Oklahoma and presented by him to this Museum. They are found, according to Prof. Gould, along the outcrop of a belt of red sandstone in Eastern Oklahoma. This belt is about ten miles wide and extends for a distance of fifty or seventy-five miles through several counties, particularly Cleveland, Oklahoma and Lincoln counties. Prof. Gould referred to the specimens in conversation as "sand crystals." Dr. Otto Kuntze in a similar way calls them "barite pseudomorphs." In the catalogue of a Western mineral dealer they are listed as identical with certain "silico-barite concretions" collected in Kansas. An Eastern dealer calls them "gypsum pseudomorphs." It may be inferred from these differing appellations that there is more than a little uncertainty regarding the nature of these objects.

Twelve specimens which came into the posssesion of the Museum at the close of the St. Louis Exposition vary from 2½ to 7 centimeters in diameter and from 10½ to 364 grams in weight. They assume the form of rosettes which are composed of aggregates of tabular crystals resembling lamellar-nodular aggregates of gypsum, barite and other minerals. The faces of the plates are, however, somewhat rounded on the edges as if eroded and hence not sufficiently definite in form to permit of exact measurements or determination. According to Prof. Gould they vary in size from that of a pea to a diameter of five inches. They are found both enclosed in the sandstone and weathered out.

A series of 32 specimens received later confirms the characters of the earlier lot. They include a number of globular specimens which, however, have the same structure as the rosette forms, from which they differ in the number and dimensions of the component plates. That is, the globular forms are merely thick rosettes. One specimen consists of a group of many nearly globular forms enclosed in the weathered matrix which assumes the form of a red sand. This sand appears to be the residue left from solution of the limonite cement of a ferruginous sandstone.

The rosette appears upon both sides of an approximately octagonal plate which may be designated the basal plate of the aggregate. This is penetrated obliquely by a variable number of similar plates which appear to intersect at the centre of the aggregate and project on both surfaces. These plates make angles of approximately 30° with the bases. While these plates appear as if passing through the basal plate and any important one appearing on one side may be readily discovered on the other, yet the two rosettes are never exactly alike. One is always more complex than the other and formed of smaller plates. These plates generally, but not always, lie in a confusedly whorled position. They are not simple but frequently consist of two plates inclined to each other at angles of approximately 30° and intersecting some in the vertical and some in the horizontal plane. By repetition of this compounding of plates, always at angles of approximately 30° so far as the roughness of the material will allow determination, the apparently irregular orientation of the leaves of the rosettes may be accounted for. By a greater degree of this compounding also is the greater complexity of one face over the other produced. The specimens, examined detail by detail, are decidedly unsymmetrical, yet when the broader features only are considered, symmetry of a high order is present. The rosettes on either side of the basal plate while not identical in detail are so in mass, and proportioned so that the aggregates are symmetrical with respect to the plane of the basal plate, as well as to a central axis at right angles to this plane. There is also a tendency in some of the specimens towards an axis of hexagonal symmetry in the plane of the basal plate. The secondary plates appear to so twist as to all intersect along this axis.

The position of those portions of the plates which lie buried in the body of the specimen may be followed by the cleavages upon the fractured surfaces. From an examination of these cleavages it becomes evident that the plates do not really intersect or interpene-

trate. While the projecting and visible portions are plane, that portion of each plate which is buried in the mass of the aggregate is invariably curved and frequently very strongly so. Hence a plate that appears from the general form to pass through the basal plate frequently curves sharply into almost a U shape, with both sides projecting upon the same side of the specimen while another similar U-shaped plate lies symmetrically in the opposite rosette. Other plates upon approaching plates that they appear to penetrate, terminate there in a wedge, and a similar form symmetrically placed gives the appearance of a penetration that does not exist. In some instances the aggregations are double. One specimen consists of two rosettes in parallel position which have simply touched each other and adhered. Another consists of two individuals at right angles which have grown together giving the effect of a more or less spiral, elongated form.

The exterior of the specimens is of dark reddish-brown color, while the interior is of a pale pink closely resembling the color of some pink orthoclases. When broken a good cleavage developes in the form of a minute step structure of very brilliant facets in parallel position with pronounced pearly lustre. When the fracture is examined under the magnifying glass the cleavage is obscured by a granular structure which is exactly that of a broken face of sand stone. The specimen is obviously composed of grains of sand cemented by a mineral which possesses an eminent cleavage in at least two directions. The average specific gravity of the nodules is 3.348. The individuals do not vary greatly in density from this mean. The color is discharged upon intense ignition but returns upon cooling. The color after ignition however, is fainter than before.

A slide was prepared and studied under the microscope. This appeared as an aggregate of angular quartz fragments of several sizes enclosed by a cementing mineral which completely filled all voids or interspaces between the quartz. The quartz grains were surrounded by a thin red coating which resolved under high power into groups of brownish-red isotropic spherules and ellipsoids upon the surface and in the fractures of the quartz grains. The granular fragmental material was almost wholly quartz. One small, isotropic fragment of yellow color, high refraction and no visible cleavage, presumably garnet and one good sized fragment of clouded orthoclase appeared.

The cement was an anisotropic mineral of two cleavages, one better defined than the other, which lie at an angle of 90°. There was a third cleavage parallel or nearly so, with the plane of the slide

which did not appear as cracks upon the surface of the section. The extinction was parallel to the principal cleavage, which lies in the plane of the axis of least elasticity. The index of refraction of this mineral was greater than that of the quartz. The cement throughout the entire slide was part of one crystal with the growth of which the sand grains present had not interfered. This was indicated by the cleavage, which was everywhere parallel with itself, and by the interference color which was the same hroughout the slide. The high specific gravity of the specimen and the presence of much barium sulphate, taken with the features shown in the slide indicate that this cement is barite. In this slide it was evidently cut parallel to *m* and showed the usual cleavage parallel to *c* and one set parallel to *m*.

An analysis of the specimens made in the Museum laboratories by the author gives the following result:

SiO_2	36.99
BaO	35.76
SO_3	19.20
Fe_2O_3	0.82
Al_2O_3	5.36
CaO	0.51
MgO	0.03
H_2O*	0.27
Organic†	0.32
	99.26

This corresponds with a mineral composition (disregarding the silica required for the aluminous minerals) of:

Barite	54.42
Quartz	36.99
Miscellaneous	8.59
	100.00

From the analysis it would appear that some aluminous mineral is present bu: the slides fail to disclose such in quantities required to satisfy the analysis. Inasmuch as barite frequently contains similar elements as mpurities even when well crystallized, it appears best to provisionally include the minor elements in the barite for an approximate determination of mineral composition. The mineral composition thus becomes:

Barite	63
Quartz	37
	100

This corresponds to a specific gravity of 3.77 against 3.380

* From air-dried specimen, by Penfield's method.

† Loss on ignition less water.

actually found for the individual from which the material for the analysis was taken. This discrepancy would be too great were it not for the fact, elsewhere discussed in these papers, that the specific gravity determined for these mineral aggregates is commonly too low owing to air trapped in pores, cracks, etc., which cannot be wholly removed by boiling or by the air pump. If, however, we assume that all the bases except the barite are in the form of silicates which have a density equal to quartz, the calculated density 3.62 is but slightly lower than that before obtained.

By the method described on page 27, the space occupied by the quartz and barite may be calculated. The calculation so made shows that the quartz occupies 50% of the volume of the concretion and the barite 50%. As sand naturally packed generally ncludes about 40% of voids between the grains, it appears as if the barite had crystallized between the grains of sand and very slightly pushed them apart by pressure when growing. Indeed there are in the slide examined, here and there a few evidences of slight pressure upon the cement in the shape of a rise in the order of interference color combined with a wavy extinction. These spots however are very few and very small.

These specimens are, therefore, not concretions in the narrow sense of the term, but crystal aggregates of barite with sand present as a mechanically held impurity. They bear the same relation to the known occurrences of sandstone with barite cement that the sand-calcite crystals of Fontainebleau and Devil Hill do to the sandstones with calcareous cement.

LIMONITE-SAND CONCRETIONS, SPRING LAKE, MICHIGAN

These concretions (Museum No. G. 1223, Plate XXIII) were collected at Spring Lake, Michigan, by the author. They occur on the tops of dunes where the sand has been overgrown with grasses and shrubs. In places the vegetation has disappeared and the sand has again begun to move. Thus there are formed shallow pits where the surface has been removed to depths of from an inch or two to five or six feet below the sod. These concretions lie on the surface of these pits in the loose sand. From the shallowness of some of these pits, it is evident that many of the concretions must be formed within a few inches of the original sodded surface of the dune. Inasmuch as in the deeper pits the supply of concretions is not perceptibly greater than in the shallowest of all, it appears that few, if any, of the concre-

tions originate at any considerable depth below the surface. The concretions are irregular, lumpy forms without approach to any regularity or symmetry beyond the fact that the majority of them are more or less flattened and many have one flat side. They are occasionally penetrated by minute cylindrical holes up to 2 mm. in diameter such as would be the case if they had been penetrated by rootlets. They are of reddish-brown limonite color rarely approaching a hematite-red in places. They are but slightly consolidated and may be readily reduced to their constituent sand grains by pressure of the fingers. They do not commonly exceed 5 centimeters in any dimension. In composition they are dune sand cemented by a small proportion of limonite which does not fill the voids between the grains. The limonite is merely a coating on the sand grains. Whenever the grains touch their coatings coalesce, thus cementing the sands into a concretion. There is no evidence of any nucleus in any of the specimens examined nor is there any determinable concentric structure.

There is no mystery about the origin of these forms beyond the determination of which of three or four common agents has been the predominant precipitant of the cement. The sand of the dunes in which they were found is, like nearly all dune and beach sand, of a yellowish-brown color. This color is due to a thin coating of limonite. Where the dunes have not been fixed by vegetation, this color is not noticeably lighter at the surface than it is in depth. Where a dune is fixed by vegetation a light sod often forms over the surface. Under this sod the sand is much lighter in color for a depth of a few inches than it is at greater depth. Hence it is to be inferred that the organic compounds derived from the vegetation have, as is customary, dissolved the iron oxides from that sand which lies immediately under the sod. From organic compounds containing iron dissolved in the so-called humus acids, the metal is rapidly precipitated by any one of several agents, the more common of which are spontaneous changes in the organic solvent, bacterial action, oxidation and hydrolysis. The hydrated ferric oxide precipitated is deposited by preference as a film upon the surface of the sand grains and by spontaneous dehydration forms the limonite cement.

As he precipitation has fol'owed so immediately on solution as to produce concretions within a few inches of the surface it is probable that the precipitating agent is either air in the pores between the sand grains, iron-secreting bacteria, or more probably a hydrolization of iron compounds of weak organic acids consequent upon

large dilution of the solvent when removed from the immediate vicinity of the decaying root or leaf which is the source of its supply.

Such small limonite-sand concretions forming near the surface of semi-fixed dunes are, therefore, due to an action of vegetation upon the limonite coatings of the sand grains of the dune, an origin not unlike that of the bog and pond limonites.

LIMONITE GEODES, MUSCOGEE, INDIAN TERRITORY

A series of limonite geodes (Museum No. G. 1308) of unusual character was presented to the Museum by General G. Murray Guion. According to General Guion the geodes are found in clay in the bottom of a "draw" or ravine at Muscogee, Indian Territory. These specimens are composed essentially of limonite with turgite and consist of a crust, a core and a central cavity. They are of the irregular discoid form with smooth exterior which characterizes a common type of siderite nodule. They are of moderate size. A typical specimen (Plate XXIV, Fig. 4) weighs 270 grams, has a diameter which varies from 10 to 12 centimeters and a thickness of 4 centimeters. When the specimen lies flat its horizontal projection is a decidedly irregular oval. All vertical projections and sections are ovals, slightly irregular but symmetrical with respect to the major diameter. Some specimens possess th cker and some thinner forms than this. The surface is smooth except for such roughness as is due to scaling of the lamellar crust. The color is light gray with dark brown stains. Some specimens are coated with a firmly adherent yellow ochreous clay in which they appear to have been imbedded, while many specimens are perfectly free from this coating. The specimen shown in the illustration s enclosed in a light-colored laminated crust. Inside the crust and sharply separated therefrom, is the main portion of the geode, a hard, red and yellow, concentrically banded, agate-like mass of limonite and turgite. The center is occupied by a small cavity which varies in shape and size in different specimens, and suggests in outlines the central cavity often found in agates.

The shell is from 3 to 7 millimeters in thickness. Its external color is gray to brown; fractured surfaces are ight gray with dark brown and limonite yellow areas. The outer portion of the crust is almost universally light gray, while the inner parts contain more of the darker areas.

The crust is strongly laminated, especially in the outer portions. The individual laminae, which are somewhat under a millimeter in

thickness, are very brittle and break readily in some instances into little, straight-sided rhombs which are not uniform in shape or size. The hardness of this crust is about that of calcite. In appearance the material of this crust resembles a siderite partially altered to limonite. A chemical test, however, proves it to be limonite mixed with clay and a very little calcite.

Inside this shell is the core, which comprises the principal mass of the specimen. This core readily separates from the shell when the geode is broken. It consists of hard red turgite, banded concentrically with limonite. (Plate XXIV, Fig. 3.) The red portion forms by far the larger part of the core. The hardness of the core like that of the crust is about that of calcite. This core is of a smooth, earthy texture. It rubs off sufficiently to soil paper readily. The agate-like banding is disposed somewhat symmetricallywith reference to the centre and the outside. A section of the core presents an annular form. The centre of this ring is occupied by a broad red band, outside and inside of which are thin, alternating bands of yellow and red, while the broad central red band is itself made up of a multitude of minute, almost invisible bands of two shades of red.

The central cavity is small in proportion to the size of the geode. One specimen which has been sawn through the centre presents a section of an average diameter of 6 centimeters. In this specimen the section of the cavity occupies a space of 15 by 5 millimeters. The section of the opening has the form of an irregular pentagon with sharp angles suggesting a crystal outline which is common among agates. The cavity in this instance has a dark brown, slightly iridescent coating of botryoidal limonite with two small areas of colorless, transparent opal also botryoidal A thinner specimen of about 5 by 25 millimeters section when sawn through the centre reveals the central cavity reduced to a mere slit of 2 by 10 millimeters. This cavity is in the red turgite and has no limonite coating. It has, however, a partial coating of an opaque white powder, the nature of which has not been determined.

Composed of quartz, these specimens would be typical agates. Therefore it is most probable that they were formed in the same way as agates by the deposition of oxides of iron instead of silica. As in the case of agates slight changes in the conditions of deposition cause changes in the color and porosity of silica deposited, so in this instance slight changes in the surroundings or in the mother liquor have caused alternate depositions of more and less hydrated oxides of iron. Further discussion of the origin and nature of these objects would

appear unprofitable until their occurrence has been investigated in the field.

LIMONITE GEODES FROM THE OHIO RIVER

A series of four hollow limonite objects (Museum No. G. 1307) of rhombohedral form which were presented to the Museum by Dr. W. S. Gilmore prove to be limonite geodes. (Plate XXIV, Figs 1 and 2.) They are described as occurring in large numbers in clay upon the banks of the Ohio River about 30 miles from Owensboro, Ky.

They are small, weighing from 28 to 64 grams. They are all of approximately the same thickness, 25 millimeters, the same width, 25 millimeters and vary in length from 26 to 60 millimeters. With the exception of one imperfect specimen they are bounded by plane faces and are in form typical joint rhombohedrons formed between bedding planes and three systems of parallel and intersecting joints perpendicular to the bedding. Two systems of the joints are practically perpendicular to each other. The third system intersects the others at angles varying from 40° to 60°. In all the specimens two parallel surfaces which differ in color from, and are more earthy in texture and rougher than the others, are identified as bedding planes.

The surface of the geodes is yellow on the bedding planes and dull red to brown on the joint faces. Fractured surfaces are dull brown and smooth, with a yellow streak at the inside edge. The specimens are hollow, with thicker walls along the bedding planes than along the joint surfaces.

In one specimen (Plate XXIV, Fig. 2) the walls of the geode in contact with the bedding planes have a thickness of 5 to 7 millimeters, while the walls in contact with joint planes have a thickness of only 1 to 2 millimeters. This specimen happens to be double, the half-specimen or individual to which the above measurements refer having a breadth and thickness respectively of 24 and 16 millimeters The interior hollows of the unbroken geodes are filled with a tough, yellow, ochreous clay, reticulated on the surface with drying cracks.

It is very ev dent from the form and structure of these objects that they are formed at the intersection of joints and bedding planes. They do not represent actual open spaces, but rather are blocks of clay enclosed by these fractures and modified by the introduction of limonite from the exterior by ferruginous waters. These waters do not appear to have deposited their iron in the joint openings them-

selves to any considerable extent, as in this case there would be-instead of individual geodes, a cellular honeycomb structure of limonite enclosing clay in its meshes.

The limonite has been deposited principally, perhaps wholly, where the ferruginous waters have soaked into the clay as coatings upon the individual clay particles. Not filling the joint fractures, the limonite coatings of adjacent specimens do not commonly adhere. When they do adhere, compound or twin geodes are formed. The source of the iron cannot be determined, as practically nothing is known of the mode of occurrence of these objects. Except for the outer form, these objects simulate closely those concretions that are assumed to originate in the decomposition of a pyrite nodule and the deposition of the resultant oxide of iron around it. It is a question if many of the hollow iron concretions may not be geodes of this nature, although it is certain that not all are. If the deposition of iron oxide continued long enough, such a deposit would become one of argillaceous limonite.

NODULES FROM THE CHALLENGER AND ARGUS BANKS IN THE ATLANTIC OCEAN

While engaged in collecting fish for this Museum, Dr. Tarleton H. Bean, on the 12th of October, 1905, dredged from the Challenger Bank sixty-four calcareous nodules. The following day he dredged from the Argus Bank twenty-eight similar nodules. These specimens, now a part of the Museum collections (Museum Nos. G. 1323–30), are sufficiently problematic in character to be worthy of some study, especially as, if of a certain character, they would have an important bearing upon geological and geographical problems of great interest.

The Challenger Bank, whence the larger number of specimens were secured, is a shoal of from five to ten miles diameter, rising abruptly from the depths of the sea to within twenty-four to thirty fathoms from the surface. The Bank lies thirteen miles southwest of Gibbs Lighthouse, Bermuda, and is separated from the Bermuda Bank by a space of three and one half miles of deep sea, where soundings exceeding 1,000 fathoms have been taken. The Argus Bank is a shoal of similar dimensions and depth of water about twelve miles southwest of the Challenger Bank, from which it is separated by a trough of five hundred fathoms depth. There is no shallow water connection between these two banks, nor with any other shoals or land.

It was the opinion of James D. Dana* that these two banks were, in comparatively recent historical times, islands, which were even mapped as "The False Bermudas." Early accounts of these banks described them as "rocky ledges."† The ship Challenger visited the bank of that name upon the 23d of April, 1873. Upon its map of the region‡ the character of the bank is given as coral. Sir C. Wyville Thompson,§ who was with the Challenger expedition, says: "The bank, which seems to be about five miles across, consists mainly of large rounded pebbles of the substance of the Bermuda serpuline reef. There is an abundant growth all over the pebbles of the pretty little branching corals, *Madracis asperula* and *M. hellana.*" He mentions also that starfish and other animals were brought up in the dredge. Mr. Bean, dredging in 28 fathoms, found that the bottom was covered with the nodules under consideration, which are doubtless identical with Sir Wyville Thompson's pebbles. The nodules were, however, imbedded in calcareous ooze, and although covered by living forms, the branching skeletons, which may well correspond with *Madracis*, appear from inspection of the dried specimens to have been dead sufficiently long to become encrusted with bryozoa and nullipora.

If these nodules are rolled fragments of serpuline limestone, both the existence within a few hundred years of the False Bermudas and their extremely rapid subsidence is as good as proven. The three and one half miles of deep sea which separate the banks from the nearest reefs offer an insuperable obstacle to the transportation of pebbles in such large numbers. Such nodules of fragmental origin also could not form *in situ* under present conditions, for wave action at depths of twenty-four to thirty fathoms is either very weak or entirely lacking. The current of three knots has not sufficient power to round boulders of such size. If, however, they are accretions, they have little or no apparent bearing upon these questions, and the interest in them arises from other sources.

The nodules from the Challenger bank (Plate XXV) in the possession of the Museum were dredged, as already stated, from a depth of about twenty-eight fathoms. The nodules are roughly spherical, with pitted and irregular surfaces. When collected, they were covered with living hydrozoa, other animal forms and algae. The

*Corals and Coral Islands, p. 187.

†Ibid.

‡Challenger Report: Narrative: Vol. I, facing p. 149.

§Voyage of the Challenger: The Atlantic, Vol. I, p. 333.

nodules are of a light cream color, with membranous patches of red and brown dried organic matter, (*Meloboesia*) which continues to produce the characteristic pungent odor of drying marine vegetation. From the weights and dimensions of 56 individuals, the writer has calculated the average size and shape. It is a rounded body, like a slightly crushed sphere, 9.9 centimeters long, 8.7 centimeters wide, and 7.6 centimeters thick. Its weight is 340 grams. The variation of size in the nodules at hand is considerable, the maximum diameters of the 56 individuals lying between 6.8 and 14 centimeters, and the minimum diameters between 5.7 and 11.2 centimeters. The corresponding weights are 118 and 940 grams. Between these limits the sizes and weights of the nodules are distributed with a fair degree of uniformity. While the individual nodules frequently depart far from a true spherical form, they appear on casual inspection to do so in all possible directions, and with no tendency toward any other definite shape than the sphere. When the dimensions of all the specimens are tabulated, however, it appears at once that the majority of the forms are such that the three perpendicular axes or diameters are unequal, and the length of the intermediate is an arithmetical mean between the longest and the shortest diameter. The average nodule, as described above, also has this form. Few of the specimens depart far from these proportions. Many, however, while maintaining their ratios between major, median, and minor axes do depart materially from the form of the spheroid of the same axes. One is in the form of a cone with a large, shallow depression in its base, well to one side of its axis. (Plate XXVI, Fig. 6.) Others have slight flattenings and concavities which are suggestive. Frequently, on the flatter sides of the nodule there will be slight depressions a little to one side of the centre. These forms dimly but persistently suggest half-obliterated forms of familiar gastropod shells. (Plate XXVI.)

The specific gravity of a specimen weighing 540 grams was found to be 2.30.*

The surface of the nodule (Plate XXV) is always of an irregularly rough or warty appearance. It is composed entirely of the skeletons of calcareous encrusting organisms which are chiefly corals, bryozoa and algae. In places the surface is covered with cylindrical branching forms, (*Madracis ?*) which may attain a height of 8 mm. and a diameter for individual cylinders of perhaps 2 mm. These forms were all dead when the specimens were collected, and are in all instances

* See p. 50 for cause of low results.

thickly covered, and partially obliterated by other incrustations. Other portions are covered with somewhat smaller club-shaped branching forms of bryozoa. The entire surfaces of all the specimens are covered with films of encrusting bryozoa, and of a nullipore allied to *Meloboesia* of which many were living when the nodules were collected. The surfaces show also a multitude of forms of other calcareous organisms, including curved worm tubes, fan-like forms, etc., of occasional occurrence. The specimens collected in 1873 by the Challenger were covered with living *Madracis*, which appear in the present specimens to have been replaced for the most part by nullipora and by bryozoa of encrusting rather than branching forms. The larger branching corals, etc., are confined to one-half of the surface, the other half being fairly smooth, and coated only with the smoother encrusting forms. This smooth half probably is the part embedded in the calcareous ooze from which the nodules were dredged. To some specimens are attached completely encrusted shells of sizes up to 45 millimeters. (Plate XXVI, Fig. 4.) The nodules are penetrated frequently by syphon tubes of a Pholas-like shell. These shells were all dead when collected and filled with calcareous sand. Some of the boring mussels are also represented by long-dead shells. There are also numerous serpula-like calcareous tubes penetrating the nodules in every direction. The calcite of the surface is of a friable, chalky, and earthy character, giving no indications of macroscopic crystallization. For purpose of study several specimens were sawn through the centre with a hack-saw. These sections (Plate XXVII) exhibit a chalky, cellular limestone, becoming more solid and denser toward the centre. The cells possess no regularity in form, size, or distribution. Some of the openings are sections of the syphons of *Pholas* or some allied form, of worm tubes and of pelecypod shells; more are merely irregular cavities in the limestone. Towards the centre the cells are smaller, with thicker walls, and toward the surface they are larger, with thinner walls. Upon examination from a distance, the cells have a distinctly concentric arrangement, which disappears upon close examination, except near the surface. Close to the surface, and for a distance inward of six or eight millimeters, the material is in the form of concentric, irregularly waved sheets of calcite, which touch and coalesce in spots enclosing elongated, empty cells lying approximately parallel with the surface. Upon the outside of the nodules there are, in places, thin encrusting bryozoa and algae, which arch away from the nodule in a similar manner. This type of cellular structure dies out

gradually toward the center by a thickening of the walls and a shortening of the cells to approximately equidimensional forms.

The calcite of the body of the nodule is continuous with that of the encrusting forms. There are certain exceptions to this, however. A nodule (Plate XXVI, Fig. 2, and Plate XXVII, Fig. 2) of a shape suggesting an enclosed shell, and about ten centimeters in diameter, when opened disclosed the very light cellular calcite to a thickness of ten to fifteen millimeters, and enclosing an annular core of denser cream-colored rock with a line of demarcation perfectly sharp. This hard material has the shape of a curved loop three millimeters thick, inside of which the cellular material again occurs. It appears to be a section through the shell of a large gastropod. Other sections of specimens display the same character. Nearly all the nodules which were opened contained shells of *Pholas*, or of some allied form. Some specimens of the boring mussels were found, as well. The Pholas-like shells had been dead for some time, and were filled with calcite sand, but the syphon tubes penetrated in every instance either quite to the surface or to within one millimeter of it. Small gastropods completely enclosed and the calcareous tubes of worms are of frequent occurrence.

Such are the nodules from the Challenger Bank. The twenty-eight specimens collected October 13, 1905, from the neighboring Argus Bank are of the same general character, but differ in some respects. They are smaller, and much more irregular in outline, as well as darker colored from the presence of the calcareous algae in larger numbers. They came from a depth of from 28 to 30 fathoms. They vary in diameter from three to eight centimeters, and in weight from 5 to 212 grams. Some of the nodules have the spheroidal form of those from the Challenger Bank, but many have no regularity of shape whatever. Some of them are simply shapeless intergrowths of branching coralline forms, and others appear to be encrustations upon flat shells of various shapes and sizes. The variety in form and size of the specimens from the Argus Bank is well demonstrated by the specimens forming the bottom row of Plate XXV.

A chemical analysis of the substance of a nodule seeming desirable, the inner part of an average specimen of about eight centimeters diameter from the Challenger Bank was taken for the purpose. After about one centimeter had been removed from the outside by chipping, the remaining portion was pulverized to pass a 40-mesh sieve and quartered down to convenient bulk for analysis. The analysis by the author gave the following result:

ANALYSIS OF THE CENTRE OF A NODULE FROM THE CHALLENGER BANK.

CaO	49.66
CO_2	42.92
MgO	2.38
Na_2O	0.34
MnO	0.05
FeO	0.12
Al_2O_3	0.58
SiO_2	0.11
SO_3	0.55
P_2O_5	0.02
Cl	0.37
Loss in ignition*	2.93
	100.03
Less O = Cl_2	0.08
	99.95
This corresponds to:	
Calcium carbonate	88.61
Magnesium carbonate	4.98
Ferrous carbonate	0.21
Manganese carbonate	0.08
Miscellaneous,	6.07
	99.95

A magnesia determination was also made upon about two grams of the extreme outer portion of the nodule. 5.12% of magnesia was found, corresponding with 10.70% of carbonate of magnesia. Thus it appears that the exterior of the nodule is more magnesian than the interior.

Inasmuch as the nodules occur isolated on a small bank in the midst of the Atlantic, away from any possibility of impregnation or alteration by waters flowing from pre-existing mineral veins, the presence or absence of minute proportions of the heavy metals is of importance as it bears directly upon the much disputed question of the origin of ore deposits by lateral secretion or ascension. The isolation of the material removes wholly the serious doubt present in most determinations of this character as to whether any metals found may not have originated in mineral veins and later impregnated the surrounding rock. Consequently a search for traces of copper and lead in thirty-seven grams of the nodule material was carried out with great care. There was not a trace of either metal present.

* Less CO_2. Chiefly organic matter and some water. The organic matter makes itself very evident upon igniting the specimen, both by its odor and by blackening.

The magnesian character of so recently formed a limestone of organic origin is somewhat unexpected, even though analyses of reef rock, coral limestone, and coquina invariably show magnesia in similar quantity. The composition of these nodules is essentially that of the Bahama reefs and of other limestones of comparatively recent organic origin.* There are ancient crystalline marbles (e.g. Vermont) which are shown by analysis to have a similar constitution as regards magnesia.

While the source of the magnesia is undoubtedly the magnesian salts in sea water, the *modus operandi* of the transfer from the sea salt to the nodule appears doubtful. There are three possible methods: 1. Formation of the nodules by direct chemical precipitation of the two carbonates; 2. Metasomatic replacement of calcium by magnesium; 3. Secretion of magnesium carbonate with the lime by organisms. The present tendency of geological belief is towards the replacement hypothesis, although there are yet those who believe the older dolomites are direct chemical precipitates. The application of the theory of replacement of lime by magnesia to the present case meets serious objections.

Experimental studies of the replacement of calcium by magnesium in carbonates indicate that under certain abnormal conditions of pressure and temperature such replacements readily occur.† Also a co-precipitation of carbonates of lime and magnesia may be produced under conditions of concentration of the mother liquor which cause it to differ widely from sea water in character. On the other hand, experiments by Bischof,‡ and others have indicated that under normal conditions either such replacement does not occur or takes place so slowly that an experiment of several years' duration yields no perceptible result. So eminent an authority as Mendeléef, however, states that such replacement can occur and will proceed until a condition of equilibrium dependent upon concentration and temperature is attained.§ Such an origin of dolomitic limestones necessarily postulates that they are formed under two sets of widely variant conditions, under one of which the equilibrium is reached at from one to ten per cent magnesium carbonate, and under the other the equilibrium is reached when the magnesium carbonate in the dolomite attains a proportion not greatly below 45.65%, which corresponds to the double salt $MgCO_3.CaCO_3$. Limestones with magnesian content

* U. S. G. S. Bull. 228.

† Fouque et Levy: Synthese des Mineraux, p. 204.

‡ Bischof: Chemical and Physical Geology, vol. III, p. 167.

§ Mendeléeff: Principles of Chemistry, vol. I, ch. 14, footnote 11.

between these limits are of very unusual occurrence, as are carbonate rocks with magnesia much in excess of that in dolomite. Experiments by various chemists and experimental geologists have amply demonstrated that a co-precipitation of magnesia and lime carbonates under normal conditions of concentration, pressure, etc., is impossible. The depth of 28 fathoms, however, corresponds to a pressure of 100 pounds to the square inch, more or less, and under this pressure and at ordinary temperatures experiments have not been carried out.

These considerations are not intended to prove that dolomites and magnesian limestones are never formed by metasomatic processes or by direct precipitation. The evidences of metasomatic origin for some dolomitic limestones which have been summarized by Van Hise* are convincing. It is, however, evident from the above considerations that the conditions under which the Bermuda nodules grew are not such as favor either of these processes of dolomite formation. Inasmuch as the nodules are evidently organic in origin, direct secretion of magnesia by the organisms concerned seems a reasonable hypothesis, especially as such an action would be to the advantage of the organism by rendering its skeleton more insoluble. As some brachiopods and all vertebrates secrete phosphates, and some sponges, diatoms, etc., silica, there seems to be no *a priori* reason why corals, etc., should not secrete carbonate of magnesia together with carbonate of lime. There appears to be an impression which is very wide spread that all such calcareous skeletons are extremely pure carbonate of lime, but a cursory examination of available literature discloses no grounds for such a belief. Dana, Geikie and Prestwich† quoting Dölter and Hörnes' work upon the dolomites of the Tyrols, note that some organically deposited limestone is slightly magnesian at the time of formation. Many writers refer briefly to the work of Forchhammer discussed in the following pages, but either minimize the importance of his results or fail to see their significance.

To determine whether calcareous organisms ever become magnesian enough to account for the character of these nodules magnesia was determined by the author in the Museum laboratory for twelve skeletons of calcareous organisms of various types. With the results of this work are tabulated twenty-one determinations by other analysts. The determinations as given in the table are of the specimens as prepared for exhibition. These naturally contain dried

* U. S. G. S. Mon. XLVII, p. 802.

† Dana: Manual of Geology, p. 134; Geikie: Textbook of Geology, p. 321; Prestwich: Geol. Vol. I, p. 113.

organic matter in considerable quantities, so that the ratio of magnesia to lime carbonates in the skeletons alone is higher than indicated by the percentages obtained for the dried specimens, which latter percentages are the ones in the accompanying table.

MAGNESIUM CARBONATE CONTENT OF THE SKELETONS OF VARIOUS MARINE CALCAREOUS ORGANISMS.

Analyses by the author in Roman type; those by other analysts in italics.

No.	Mus. No.		$MgCO_3$ %
		ALCYONOID CORALS.	
1	377	Eunicea tourneforti, Bahamas,	2.78
2	381	Plexaurella dichotoma, Bahamas,	2.11
3	—	*Isis hippuris,**	6.362
4	—	*Corallium nobile,**	2.132
5	—	Corallium rubrum, Mediterranean,†	9.32
6	314	Tubipora musica, Singapore,	3.83
		ZOANTHOID CORALS.	
7	126	Coeloria daedolea, Abyssinia,	0.35
8	—	*Astraea cellulosa,**	0.542
9	—	*Siderastraea sp., Bermuda,‡*	0.42
		BRYOZOA.	
10	1041	Flustra foliacea, California,	1.23
11	—	*Eschara foliacea,**	0.146
12	1052	Garapholas sp.,	3.99
13	—	Bryozoan? Bermuda,	5.35
14	1057	Lithoramnion racemus, Bahamas,	0.65
15	—	*Myriazoon truncatum,**	0.455
16	—	*Heteropora abrotanoides,**	0.352
17	—	*Frondipora reticulata,**	0.596
		PELECYPODA.	
18	2879	Teredo gigantea, Indian Ocean,	0.00
19	—	*Ostrea sp.,§*	0.3
20	—	*Modiola papuana,**	0.705
21	—	*Pinna nigra, Red Sea,**	1.000
		GASTROPODA.	
22	G1331	Vermetus sp., Bermuda,‖	0.35

* Analysis by J. G. Forchhammer: 1849. Bidrag til Dolomitens Dannelshistorie: Oversigt over det Kongelige Danske Videnskab. 1849, pp. 83–96.

† Polished material from a necklace.

‡ Analysis by L. G. Eakins; Bull. U. S. G. S., No. 228, p. 308.

§ Analysis by Sharples? Dana: Manual of Geology, p. 72.

‖ The incrustation of specimen shown in Plate XXVI, Fig. 5.

23	——	*Tritonium pompilius,**	0.486
24	——	*Cerithium telescopicum,**	0.189
		BRACHIOPODA.	
25	——	*Lingula ovalis,*†	3.59
26	——	*Terebratula psittacea,**	0.452
		VERMES.	
27	——	*Serpula sp. Mediterranean,**	7.644
28	——	*Serpula triqueta. North Sea,**	4.455
29	——	*Serpula filograna,**	1.349
		CRINOIDEA.	
30	P6877	Metacrinus rundus, Japan,‡	11.72
		CEPHALOPODA.	
31	——	*Nautilus pompilius,**	0.118
32	——	*Ossa sepiae [Sepia sp.],**	0.401
		ALGAE.	
33	——	*Lithothamnium nodosum,* §	5.5

It may also be noted that Sharples‖ when in 1871 he determined the phosphate in seven zoanthoid corals observed that traces of magnesia were present in all, but made no quantitative determinations. A. Damour¶ also found small quantities of magnesia in many millepores.

From the above results it appears that the algae, crinoidea, vermes and alcyonaria secrete relatively magnesian skeletons, while the zoantharia, pelecypoda, gastropoda and cephalopoda secrete skeletons which are only slightly magnesian.

These analyses thus explain why the inner portion of the nodule analysed by the author, (p. 45) is less magnesian than the outer part. This nodule like many of the others was formed in and around a large gastropod. The more highly magnesian corals, serpulae and algae of which the nodule is composed are in the central part diluted by the less magnesian gastropod material. It is probable that the magnesium of the outer part is also somewhat increased by that re-solution of the skeletal material which is always taking place.

If under present conditions corals, etc., secrete skeletons which may contain over ten per cent carbonate of magnesia, may they not, under palaeozoic conditions, when, as is usually conceded, the sea

†Analysis by T. Sterry Hunt: Logan's Geology of Canada, 1863. The ash analyzed was 61 per cent of the whole shell and gave 2.88 per cent Mg O, whence the equivalent Mg CO_3 for the entire shell has been calculated.

‡Cirri and pinnulate arms from an alcoholic specimen. The organic matter is 22 per cent.

§Analysis by Gumbel; Geikie: Textbook of Geology, p. 482.

‖Sharples: Am. J. Sci., III ser., vol. I, p. 169.

¶Dana: Manual of Geology, p. 72.

water was very different in composition and possibly far more corrosive than at present, have protected themselves by secreting relatively insoluble dolomite skeletons?

From their composition and structure it is very evident that these objects are accretions and not rolled fragments of preexisting rock. Therefore they have no bearing upon questions relating to subsidence. From the continuity between the living covering of the nodules and the calcite of the interior, as well as from the detection under the microscope of organic structure in this calcite it becomes certain that the accretions are of organic growth. They are not, however, individual animals, for organisms of many kinds are intermingled in them. They owe their existence to a sequence of events substantially as follows: The surface of the bank was covered with a soft calcareous ooze upon which coralline organisms could get no foothold. Upon this ooze certain gastropods and other shells were able to live. Also it is possible that the shells of dead animals may be transported to the bank by the current of the Gulf Stream. The Challenger secured living starfish there and other forms of li e. Such gastropod, echinoid and other shells provided the firm anchorage denied by the ooze for encrusting calcareous organisms of many kinds. These, growing generation over generation, have built up the nodules. If the growth of the nodules is more rapid than the deposition of the ooze, then they will eventually coalesce and form a surface from which a coral reef may grow upwards toward the surface.

THE SPECIFIC GRAVITY OF CLAYSTONES

When it was attempted to compare the specific gravities of the concretions herein described with the densities of other concretions, it was found that apparently such densities had never been determined. Therefore after the specific gravities of the specimens strictly comparable with those under consideration had been secured, the work was continued by the determination and comparison of the densities of fifty-four claystones from eight localities.

The specific gravities were obtained in the usual manner by weighing in water after immersion to complete saturation. Claystones are permeable to water and absorb it in large quantities, but, after the first few minutes, very slowly. A constant weight in water is seldom attained with less than twelve to twenty-four hours immersion. Frequently the weight is appreciably constant only after treatment for several days.

Claystones cannot be boiled to hasten saturation as they disintegrate to a serious extent. For specimens of this character the use of the air pump is of but little value. This very slow permeability of partially saturated claystones is a necessary consequence of the peculiar mesh-like structure already described by Emerson.* The rate of absorption becomes less as the outer parts become saturated until it is so small that increase in weight of the specimen under treatment is masked or imperceptible for periods as great as 24 hours. The last air of the interior is trapped and can be removed only by solution in the water. This solution is greatly impeded by the slight mobility of water confined in the capillary spaces so that the dissolved air can be removed by only slow diffusion unaided by convection currents in the water. The density obtained for claystones is therefore less than the true density by a quantity which is greater the thicker the specimen. It is undesirable, however, in order to avoid this presumably small and regular error, to introduce the error due to solution of cement and consequent disintegration of the surface which would arise from too prolonged immersion of the specimen. This latter error which is found to be very large and also very irregular has to be guarded against most carefully. This disintegration from the surface of clay stones in water is so great with specimens from some regions that all attempts to ascertain their density proved futile. Where an abundance of material may be sacrificed in the work, pycnometer methods may possibly yield results free from these errors but the experience of the author has been that little dependence can be placed upon pycnometer determinations made upon such small quantities of material as could be sacrificed for this purpose. Hence no such determinations were made. The specific gravities of the claystones examined are tabulated on page

When the forms of the specimens were compared with their densities an apparent relationship between the density and relative thickness appeared. To properly compare these features a numerical value for the rotundity or flatness of the specimen is absolutely necessary. As a suitable expression for the variation of form in this respect the term modulus of rotundity is proposed. The diameter of that circle which has an area equal to the horizontal projection of the concretion is calculated or measured. This divided by the extreme thickness gives the modulus of rotundity, a number which is greater for the thinner forms and which becomes unity for the

*U. S. Geol. Survey, Monograph XXIX, p. 717.

sphere. This number is of a very convenient magnitude, varying from 1 to 16.4 for the forms in the collections. This modulus is the reciprocal of the coefficient of rotundity.

TABLE OF SPECIFIC GRAVITY AND MODULUS OF ROTUNDITY OF CLAY-STONES.

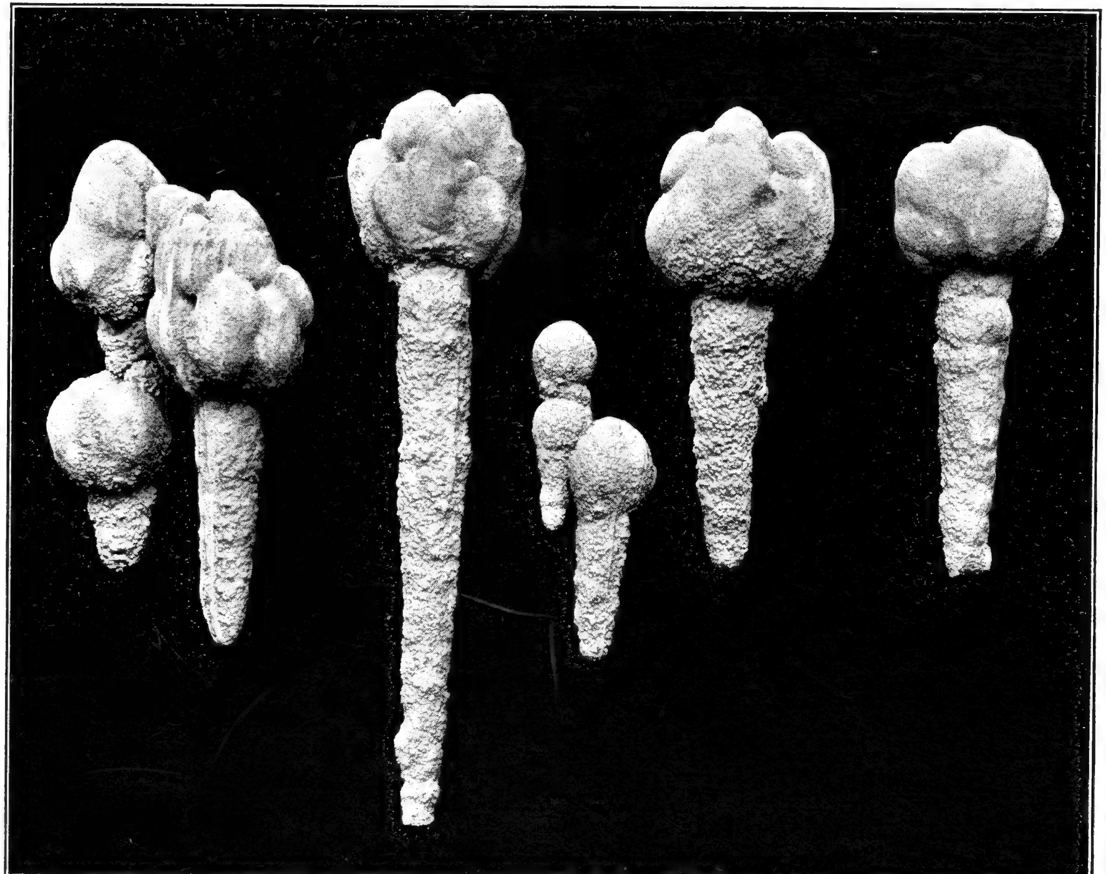
No.	S.G.	M.R.	Locality.	Mus. No. G
1	2.77	11.6	Riga, Vermont.	41–1
2	2.76	8.9	"	39–1
3	2.76	8.2	"	66–2
4	2.75	9.8	"	39–2
5	2.75	11.1	"	41–3
6	2.74	11.1	"	72–3
7	2.74	10.6	"	72–1
8	2.74	8.8	"	69
9	2.73	6.3	"	72–2
10	2.71	5.1	"	39–3
11	2.68	3.6	"	37–3
12	2.68	2.6	"	38–1
13	2.67	4.1	"	37–4
14	2.67	2.9	"	69–4
15	2.66	2.0	"	40–1
16	2.66	1.7	"	40–2
17	2.66	1.7	"	69–2
18	2.65	3.3	"	38–2
19	2.65	1.7	"	40–2
20	2.64	1.9	"	69–3
21	2.63	3.5	"	37–2
22	2.63	3.0	"	37–1
23	2.77	7.3	Connecticut River.	805–6
24	2.73	8.1	"	805–8
25	2.73	4.6	"	76–2
26	2.71	5.6	"	752–2
27	2.71	1.8	"	805–7
28	2.70	5.9	"	70–2
29	2.70	3.0	"	70–1
30	2.69	4.5	"	55–2
31	2.69	3.9	"	75–1
32	2.69	2.0	"	805–2
33	2.69	1.5	"	805–4
34	2.69	1.5	"	805–5

35	2.68	3.4	Connecticut River	805–1
36	2.68	3.3	"	55–1
37	2.68	3.2	"	76–3
38	2.68	2.9	"	805–3
39	2.68	2.7	"	75–2
40	2.67	5.3	"	76–1
41	2.67	3.4	"	70–3
42	2.67	3.4	"	805–9
43	2.70	2.0	Hartford, Connecticut.	751
44	2.76	3.0	Deerfield, Massachusetts.	753–2
45	2.73	1.6	" "	753–1
46	2.93	16.4	South Hadley, Massachusetts.	73
47	2.71	8.1	Charleston, New Hampshire.	755–1
48	2.67	2.2	" "	755–3
49	2.66	3.9	" "	755–2
50	2.78	7.8	Cumberland, Maine.	757–1
51	2.77	2.4	" "	757–2
52	2.76	2.3	" "	757–3
53	2.68	5.4	Broad Cove, Maine.	756–2
54	2.68	3.4	" "	756–1
55	2.63	1.4	" "	756–3

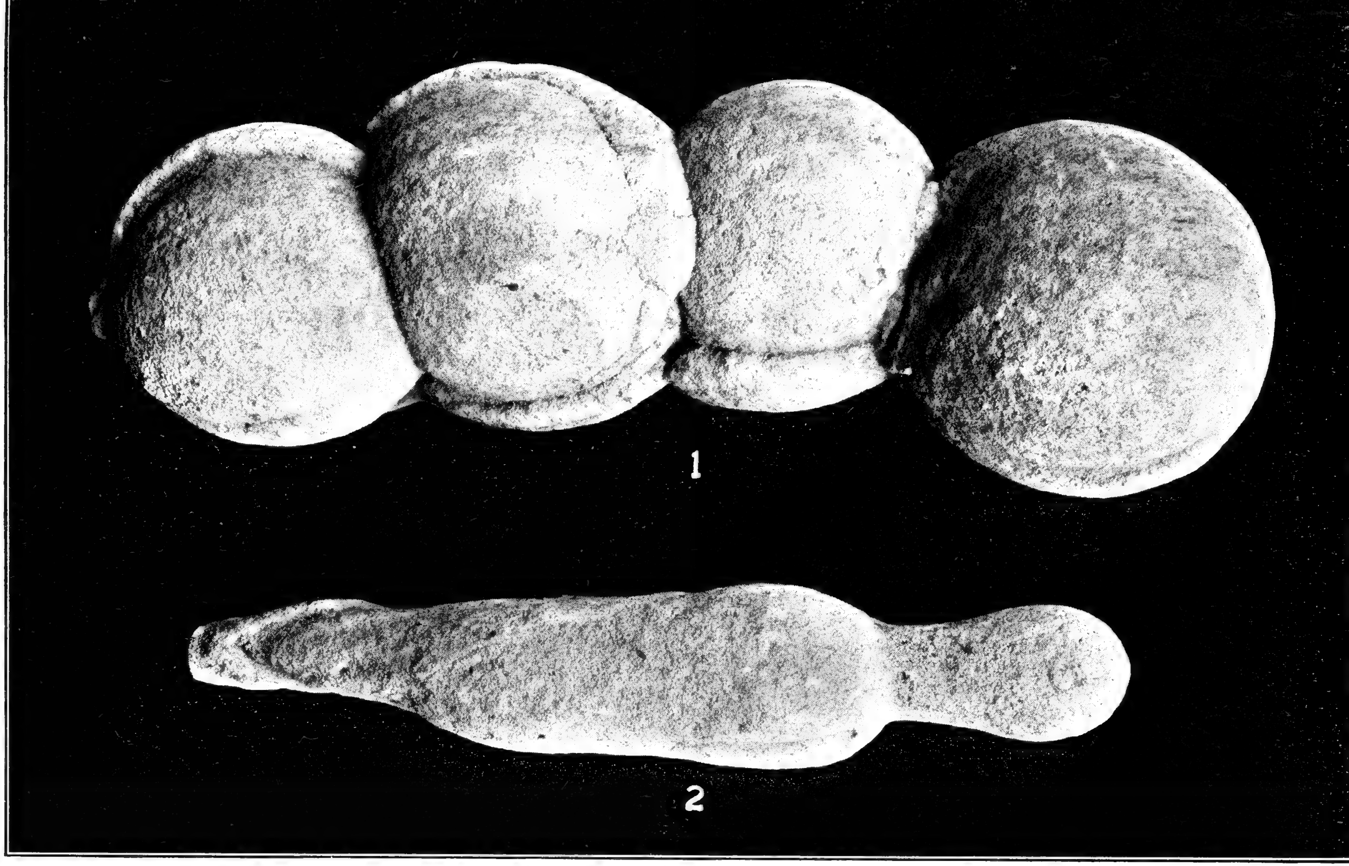
Of all the specimens examined those from Riga, Vermont, are available in the largest numbers and vary most in thickness. Their forms are extremely simple varying from nearly spherical to thin, wafer-like disks with but few irregular shapes. They are therefore favorable specimens for study. Of the twenty-two from this region examined, the twelve with specific gravity below 2.70 have a modulus below 5. The ten specimens with specific gravity above 2.70 have a modulus above 5. Thus the modulus of rotundity seems to increase in a general way with the density. It is probable that the increase in density with increased thinness is only apparent and is really due to those defects inherent in the methods of determination which have already been stated.

Claystones, as impure concretions, are subject to many purely fortuitous variations in composition. It is of importance to note that almost any such variations from normal composition will give a specimen of greater specific gravity than the typical claystone. The glacial clays in which claystones commonly occur are rock flours of varied composition. As a general rule they consist essentially of floured quartz, kaolin and kaolinized feldspars and calcite. Such

clays have a true specific gravity between 2.62 and 2.65. This clay persists unchanged throughout the substance of all claystones formed in it. Any pebble or other foreign substance in the clay is enclosed by and made a part of any claystone that forms in the proper position. With the exception of quartz any pebble likely to be encountered in concretion-bearing beds is considerably heavier than the surrounding clay. Bits of shell, frequently encountered in claystones from some localities, render the concretion in which they occur heavier than normal. Rock flour clays may, and frequently do, contain pulverized minerals of many species, practically all of which are heavier than the normal quartz and kaolin. Spots and seams stained with iron oxides, segregations of magnetic iron sand, pulverized hornblende, etc., are not at all uncommon. The cement of a claystone is, so far as known, essentially calcium carbonate. Usually it is somewhat magnesian and occasionally ferriferous. In either case the specific gravity of the concretion is increased. Fortuitous variations in composition and structure therefore commonly increase the specific gravity. It is astonishing that in bodies apparently subject io purely fortuitous changes so many and so great, this change of density with form should not be entirely masked. That it is not so masked, suggests that there are only narrow limits of structure and quality of clay and cement within which the formation of these concretions is possible.

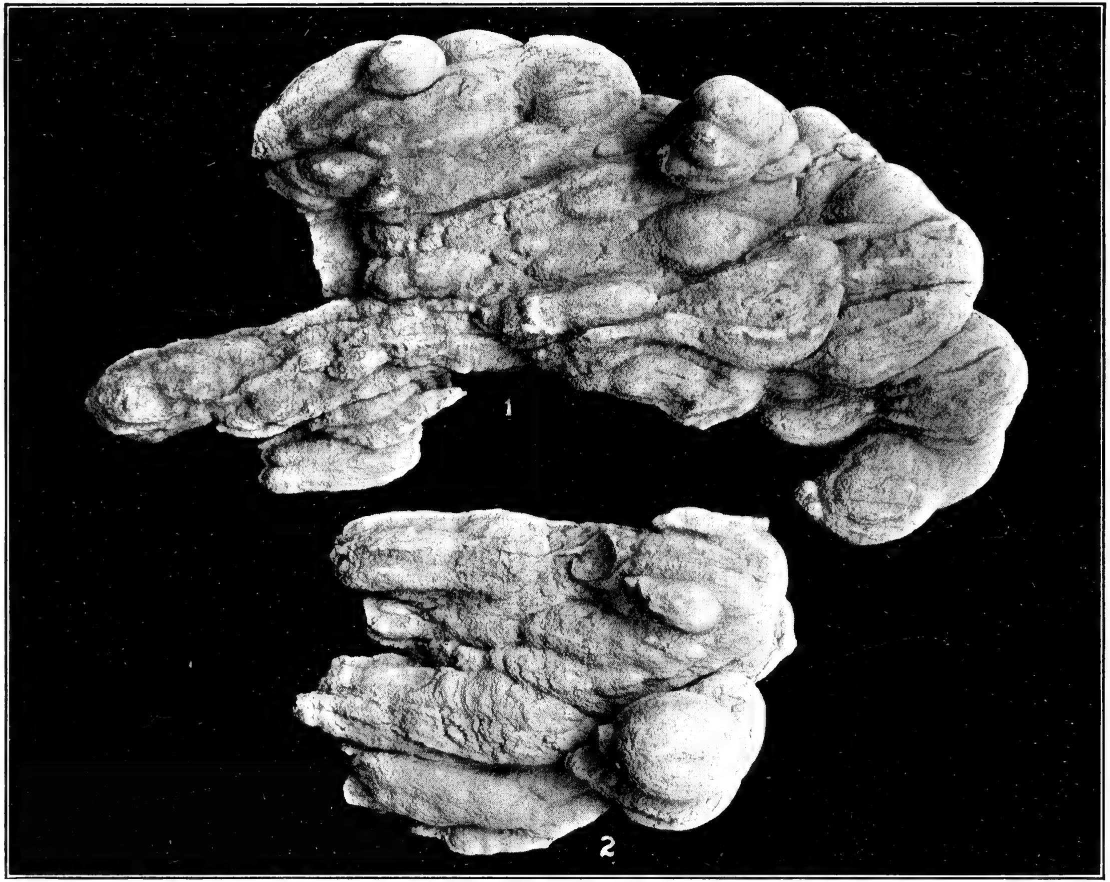


SAND-CALCITE CONCRETIONS SALTON, CALIFORNIA, $\times \frac{1}{3}$



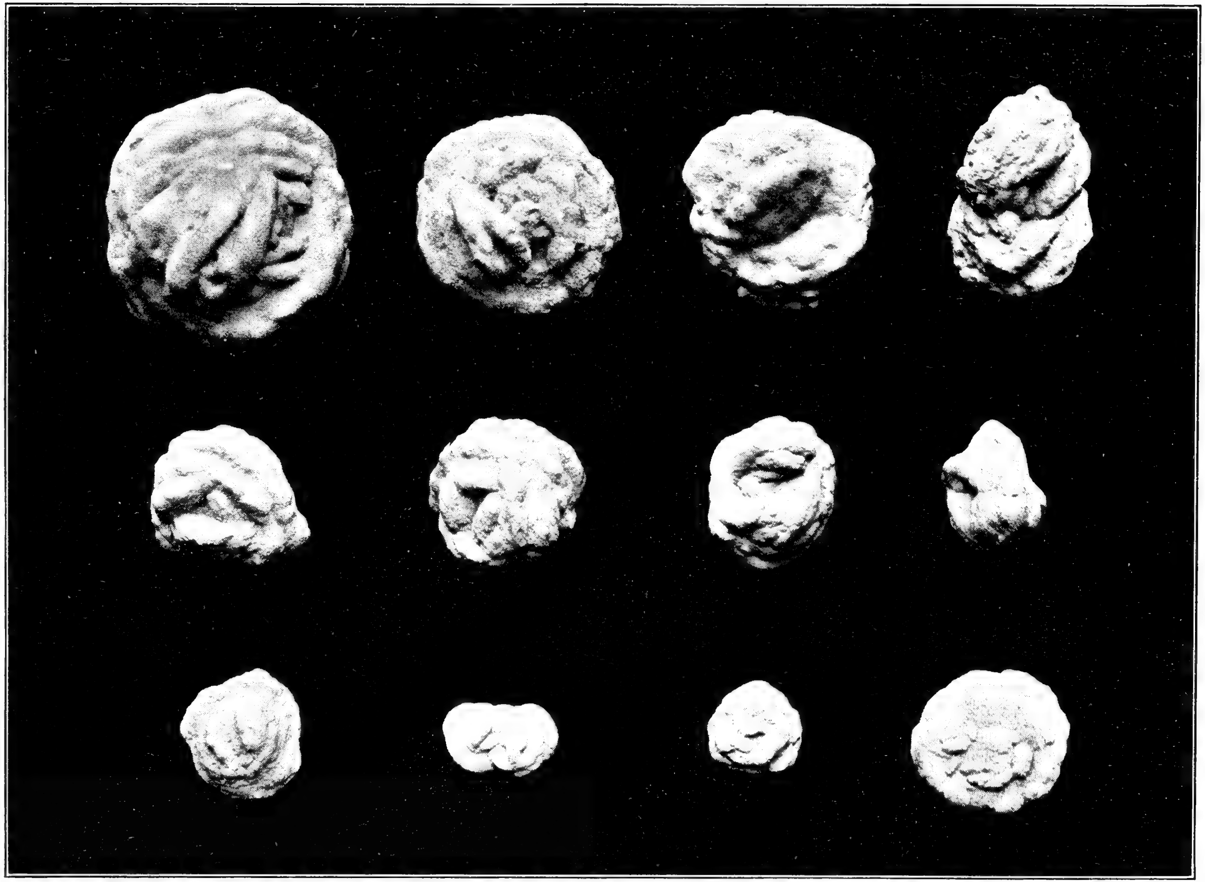
SAND-CALCITE CONCRETIONS, $\times \frac{1}{3}$

FIG. 1. Clermont, France.
FIG. 2. Saratoga Springs, New York.

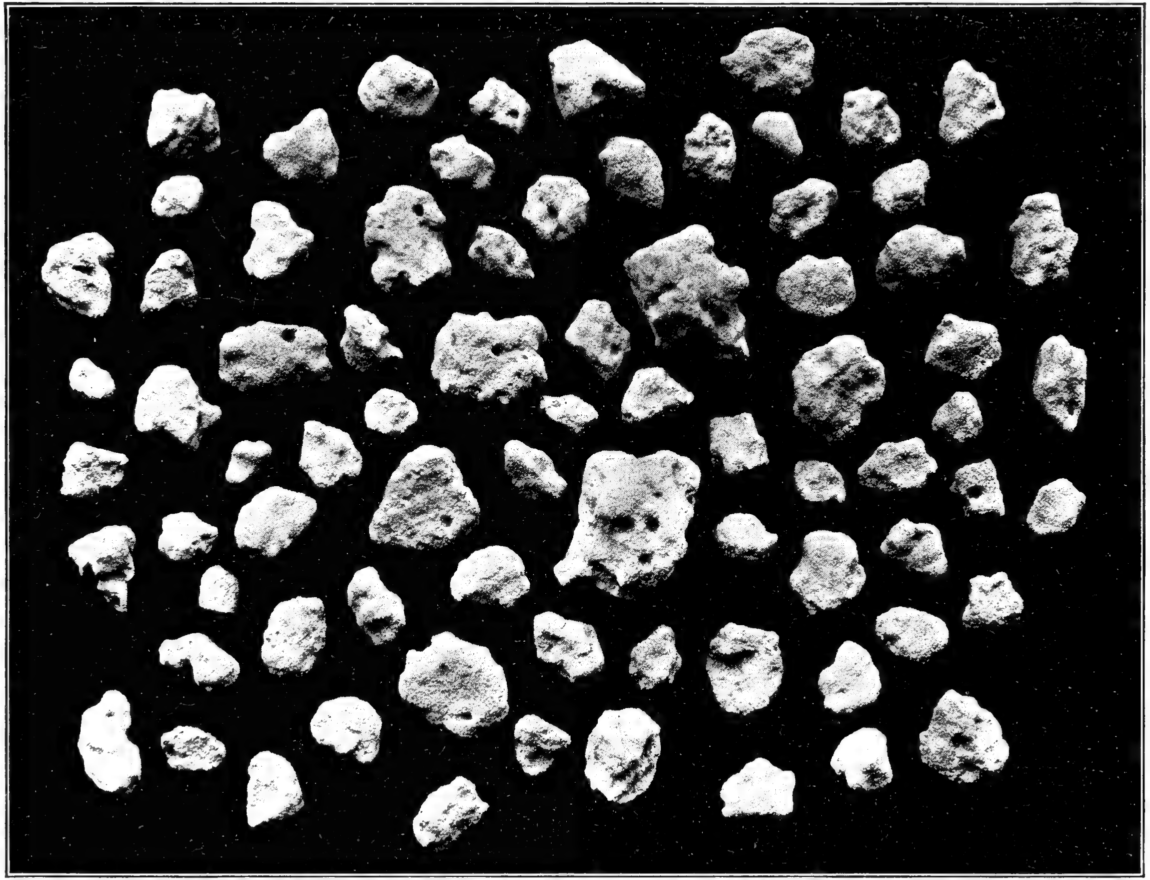


Sand-Calcite Concretions, Saratoga Springs, New York, $\times \frac{1}{3}$

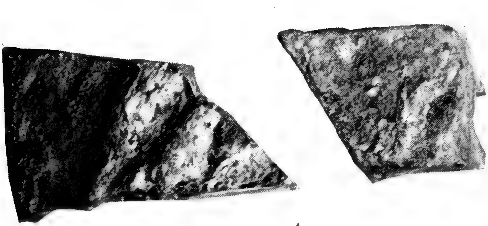
Fig. 1. Congruence of individual concretions.
Fig. 2. With a typical ovoid individual.



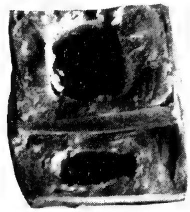
SAND-BARITE CRYSTALS, OKLAHOMA, $\times \frac{1}{2}$



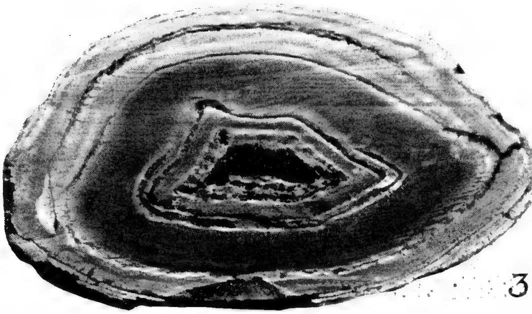
LIMONITE-SAND CONCRETIONS, SPRING LAKE, MICHIGAN, × 1



1



2

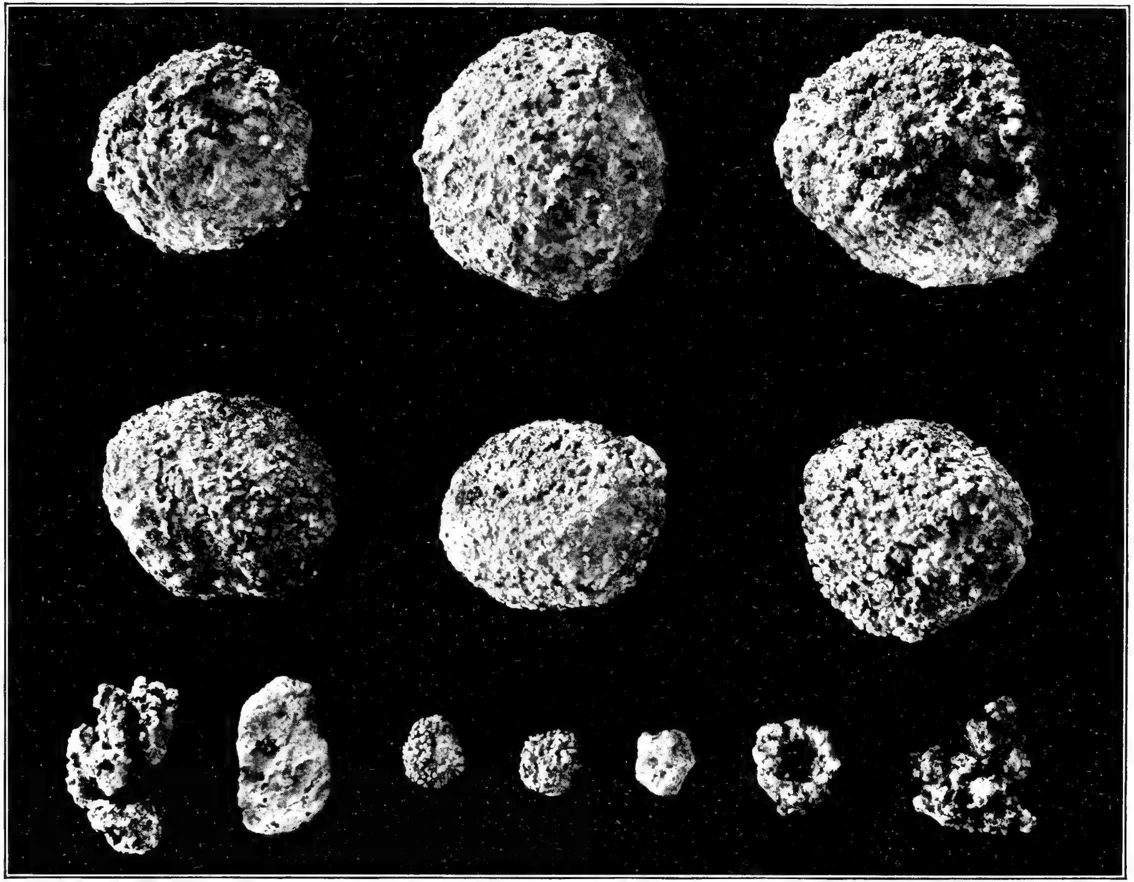


3

4

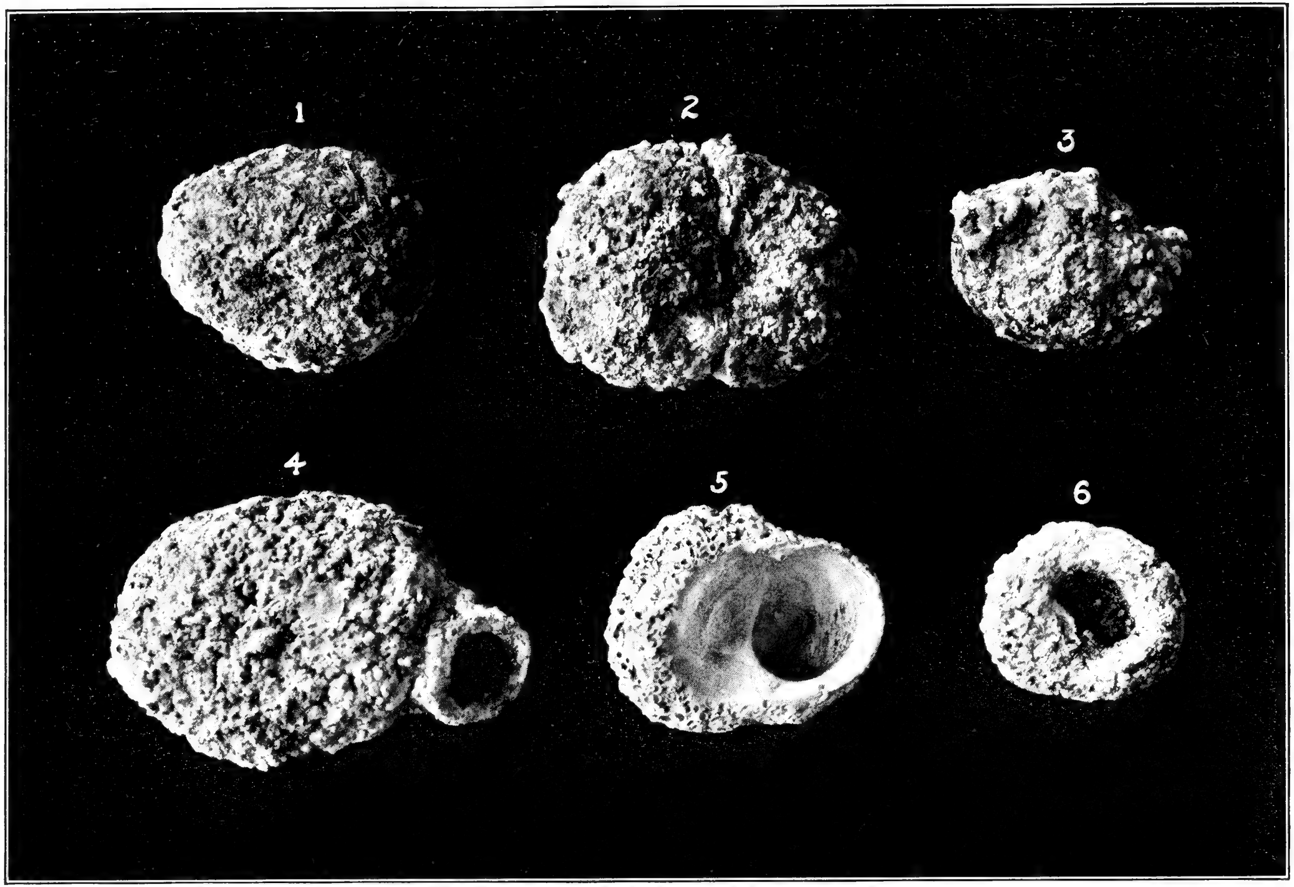
LIMONITE GEODES, × $\frac{5}{6}$

FIG. 1. Two adjacent geodes, Kentucky.
FIG. 2. Section of twin geode, Kentucky.
FIG. 3. Section of geode, Muskogee, Indian Territory.
FIG. 4. Limonite geode, Muskogee, Indian Territory.

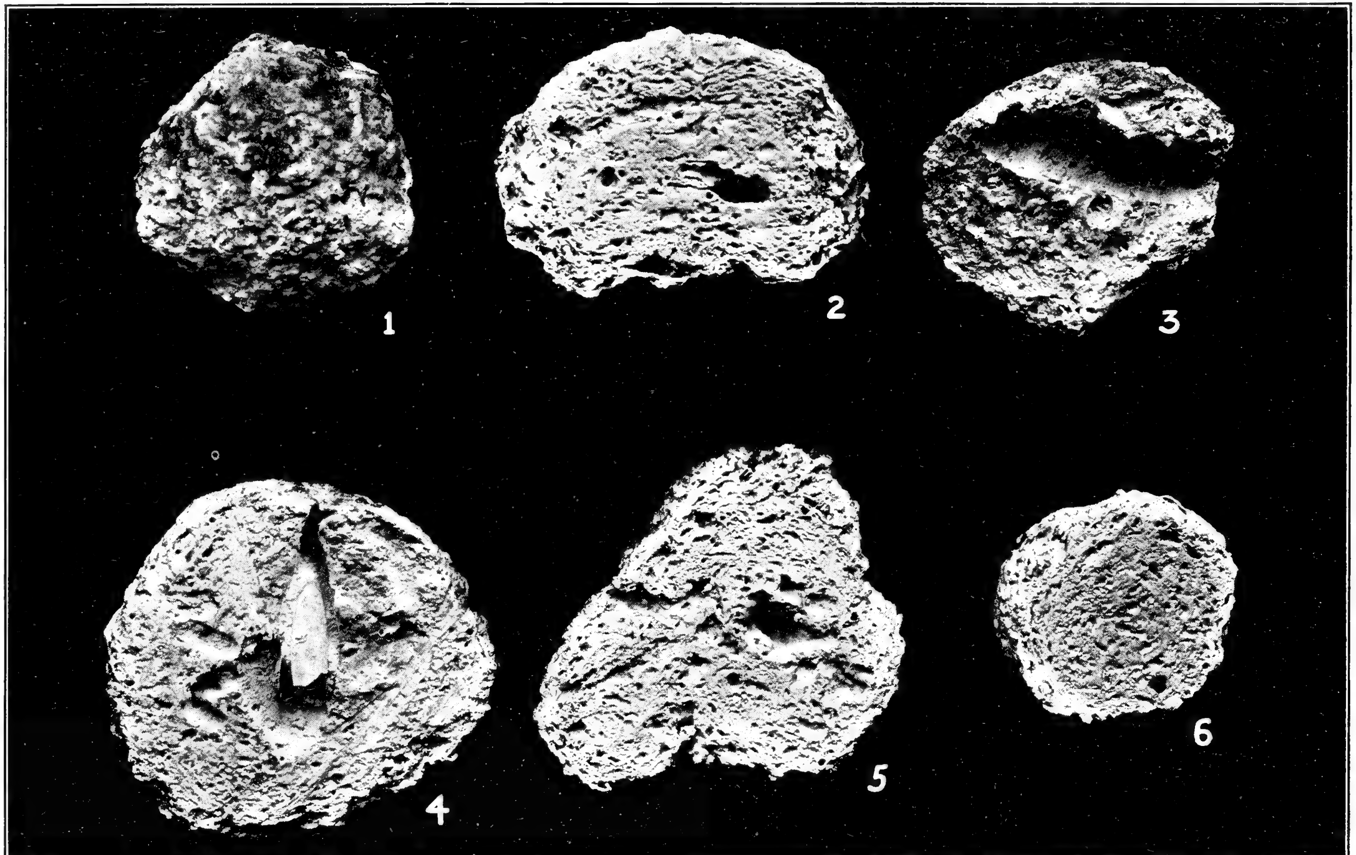


NODULES FROM THE CHALLENGER AND ARGUS BANKS, $\times \frac{2}{7}$

The upper rows are from the Challenger Bank.
The lower row is from the Argus Bank.



Nodules from the Challenger Bank, $\times \frac{1}{3}$



SECTIONS OF NODULES FROM THE CHALLENGER BANK, $\times \frac{1}{2}$

ZOISITE FROM LOWER CALIFORNIA

BY OLIVER CUMMINGS FARRINGTON

While at San Diego, California, in the spring of 1905, the writer obtained from Mr. Ernest Riall of that city several specimens of a radiated mineral, collected by Mr. Riall at the Trace mine, in the Juarez District of Lower California. This locality, according to Mr. Riall, is situated sixty miles south of the international boundary. The accompanying cut shows the appearance of a typical specimen of the mineral. It occurs as divergent groups of long, prismatic crystals irregularly penetrating a matrix of a white, granular mineral. The length of the crystal groups varies from one to three inches. Their form is essentially conical, the angle of the cone being about 10°. In coloring the cones are pink peripherally, pass interiorly into nearly colorless and at the center are brownish-gray. Their constitution of numerous individual crystals is shown by elongated brilliant surfaces into which they readily separate longitudinally, but transversely the cones break as units. The cones as a whole are translucent, but small fragments are transparent. No terminal planes can be observed on any of the crystals. The longitudinal fragments show roughly prismatic boundaries, but it was found impossible, with a reflecting goniometer, to obtain satisfactory measurements of the prismatic angles, since numerous longitudinal striations produce long series of reflections. Besides the striated planes, others not striated appear to be cleavage planes $\parallel$ to the brachypinacoid. The longitudinal fragments are colorless and transparent and show in polarized light extinction parallel to the long axis. No pleochroism is observable. The character of the double refraction is positive. In convergent light the emergence of an optic axis may be seen on such fragments. Sections perpendicular to the axis of the cone are colorless and show no pleochroism. Numerous cleavage cracks making angles of 53° with each other penetrate such sections. Between crossed nicols a polysynthetic twinning structure is seen to characterize the whole, the field being filled with lamellae in parallel position. These lamellae divide into two groups as regards width, the broader being from .1 to .07 mm. and the narrower from .025 to .012 mm. The broad and narrow lamellae alternate. The direction

of the lamellae is such as to bisect the above-noted cleavage angle of 53°. Single cleavage cracks || with the lamellae are also occasionally seen.

The interpretation of this structure is difficult, but the following may be suggested: The cleavage cracks at angles of 53° are those of prisms of which the crystal groups are composed. These prisms have the symbol 540, corresponding to an angle of 52° 44′. This is a new form for zoisite. The twins of which these prisms are made up are formed on *c* as the twinning axis and the twinning plane is some highly inclined brachy-dome such as *e* (061).

The lustre of fragments of the mineral is vitreous and the fracture sub-conchoidal. Hardness 6.5 and specific gravity, determined with a chemical balance, 3.32. The mineral fuses B. B. at 3 with intumescence, to a brownish enamel and is only slightly attacked by hydrochloric acid. Qualitative tests showed it to be essentially a hydrous calcium aluminum silicate, from which the water could be driven off only by strong ignition. Quantitative analysis by Mr. H. W. Nichols gave the following result:

		Ratio
SiO_2	38.15	3.02
Al_2O_3	29.50	1.51
Fe_2O_3	4.60	
MuO	0.55	
CaO	22.71	2.05
MgO	0.63	
H_2O	3.76	1.00
K_2O, Na_2O	tr.	
	99.90	

These ratios lead to the formula $H_4\ Ca_4\ Al_6\ Si_6\ O_{27}$, which is that usually accepted for zoisite with the addition of one molecule of water. For the determination of the water both of Penfield's methods* were employed. By the first method, that of heating in a blast lamp, 1.81% of water was obtained. The mineral did not fuse. By the second method, which consists in heating the tube containing the assay in an oven of fire-brick lined with charcoal, an additional percentage of water amounting to 1.95% was obtained. Under this treatment the mineral fused completely. The close similarity between the percentages of water obtained by the two methods, each corresponding to one molecule, suggests that the molecules may be differently combined. Thus one may be united with aluminum and the other with

* Amer. Jour. Sci. 1894, 3rd ser. Vol. XLVIII, pp. 30-37

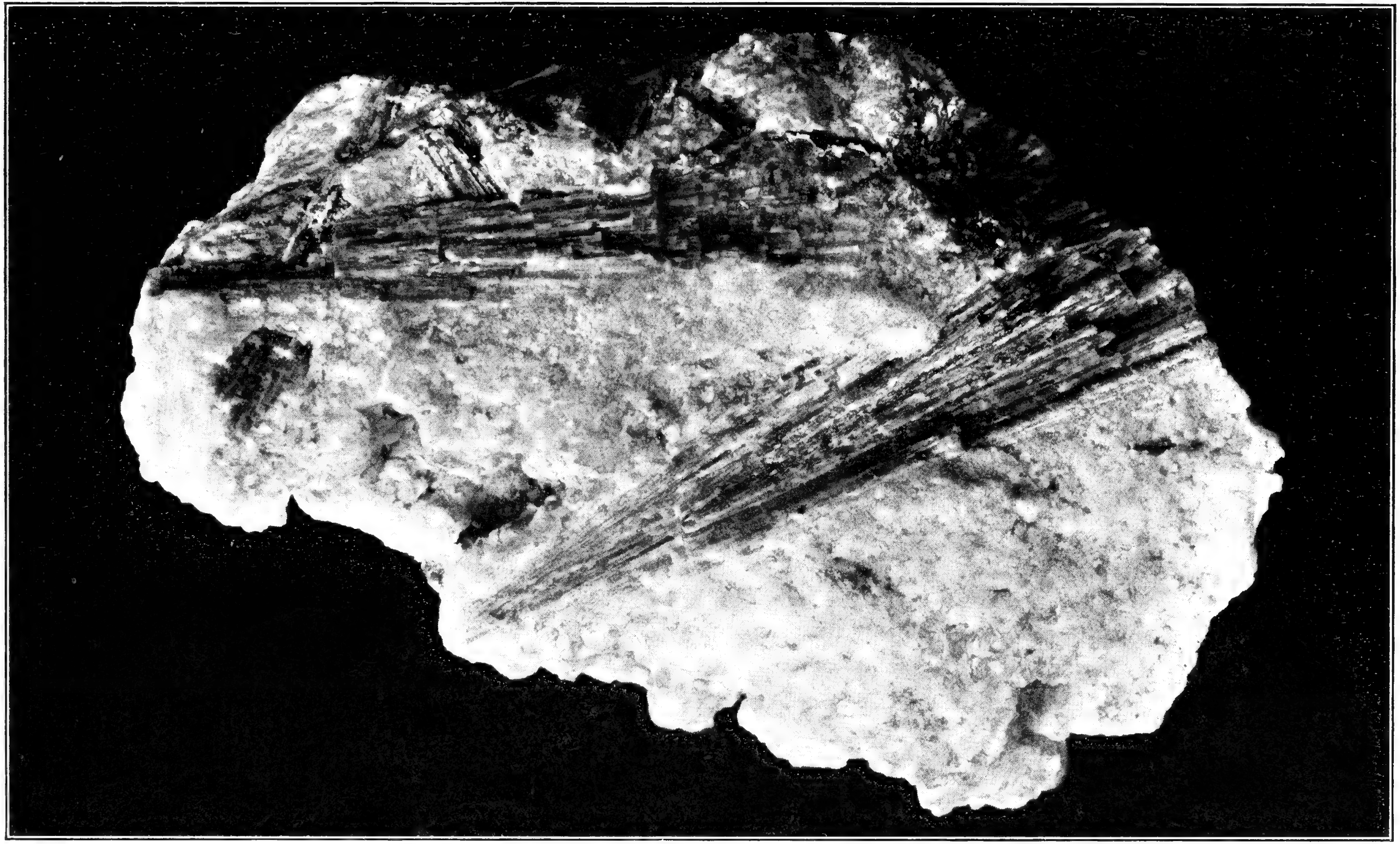
calcium. No further investigation was made of this point, however. Although the formula of zoisite is usually considered to be $H_2 Ca_4 Al_4 Si_6 O_{26}$, other analysts have obtained percentages which indicate that an additional molecule of water is present. This is true, for instance, of the analyses of zoisite from Fuschthal and Traversella quoted by Dana.* The high temperature required to drive off the water from the Lower California mineral seems to preclude the possibility of its being present as the result of alteration, as might otherwise be assumed. The amount of iron in the zoisite shown by the analysis is high for this mineral and approximates that afforded by epidote.

The mineral with which the zoisite is associated is, as stated, white and granular. In cavities it exhibits minute imperfect crystals which have a distinct, pearly luster when fractured. The blowpipe and other characters of this mineral indicate it to be prehnite and a comparison with fragments kindly furnished by Dr. W. T. Schaller leaves little doubt that it is the same mineral analyzed † by him and found to be prehnite. Its association with zoisite is of interest owing to the similarity in composition of the two minerals. The prehnite seems generally to furnish a matrix which the zoisite penetrates, but occasionally it coats the zoisite groups in such a way as to suggest that it is an alteration product of the latter. The unusual features of the zoisite seem to be therefore, its radiating habit, its high content of water and iron and its association with prehnite.

Through the kindness of Prof. L. P. Gratacap of the American Museum of Natural History, the writer was permitted to study two specimens of zoisite in the collection of that institution which were undoubtedly from the same locality as the above. They have the more usual ash-gray color of zoisite and the grouping of the crystals into cones is only partial. For the most part the crystals occur in hemispherical cavities which were, in the specimens studied, about three inches in diameter. The crystals interlace these cavities with great variations of size and direction. Many of the crystals are quite minute. All are from acicular to bladed in habit. Although some crystals have free terminations, no end faces could be discerned. These specimens show that grouping into cones is not constant for the zoisite from this locality but its occurrence at all is noteworthy.

* System of Mineralogy, 6th ed., p. 514.

† Bull. U. S. Geol. Survey No. 262, p.128



Zoisite in Prehnite, Lower California, $\times \frac{3}{2}$

ANALYSES OF IRON METEORITES COMPILED AND CLASSIFIED

BY

OLIVER CUMMINGS FARRINGTON

Chemical analyses may be collected and grouped for purposes of record and of comparison. For the first purpose it is desirable that all known analyses of the substances under consideration be collected; for the second, only those known to be complete and reliable are needed. A combination of these two purposes may perhaps be gained, however, by collecting all analyses and leaving to the judgment of the investigator the selection of those suited for the study of any particular phase of the subject. This plan is practically that which has been adopted in presenting the analyses here collected. In many cases obviously incomplete analyses are given because they represent all that is known of the chemical constitution of the meteorite in question, or because they mark a stage in its study. On the other hand, analyses which amount to little more than a qualitative determination of the presence of iron and nickel, or whose connection with a particular meteorite is uncertain, are omitted. About three hundred and sixty analyses are here included, and it is believed that they comprise practically all of importance that have been made of iron meteorites. When more than one analysis of a meteorite is given, the analyses have been arranged chronologically. For the most part the later analyses are the most complete and reliable ones, though this is not always the case. Thus those by J. Lawrence Smith, although made thirty and in some cases forty years ago, accord well with what is known of the constitution of the iron meteorites at the present day and may be considered generally accurate and reliable. The same is true of analyses by Jackson, Berzelius, Damour, and others. As shown later, the relations between structure and composition brought out by the analyses as here grouped are so definite that at the present time a knowledge of the structure of a meteorite will give a more accurate idea of its composition than inferior chemical analyses. The general plan of arrangement which has been adopted

for the analyses is that now generally known as the Rose-Tschermak-Brezina classification. This seemed the classification most desirable to employ on account of its wide use, and when it was found, as will be seen by the tables, that the chemical constitution of the meteorites follows its main divisions, its adaptation to the work in hand seems unquestionable. Under each group of the classification the arrangement of the meteorites is alphabetical. Synonyms of the meteorite names will be found on subsequent pages. The characterization of the meteorite groups which head the tables have largely been summarized from Cohen.* In considering the analyses it should be realized that some of the groups are much better known than others. Thus the ataxites and hexahedrites were thorougly studied by Cohen and their composition satisfactorily determined. The fine octahedrites have also been mostly investigated. The coarse and medium octahedrites, however, though more numerous than the groups just mentioned, are but imperfectly known and need detailed modern study. In a list following the tables meteorites of which no analysis is known are marked with an asterisk. These number about forty. In addition, many meteorites, analyses of which are reported in the tables, have never in fact been properly studied. The only extensive list of analyses of iron meteorites which has lately been previously compiled of which the writer is aware is that of Wadsworth, published in 1884.† This list includes one hundred and ninety-three analyses of iron meteorites and terrestrial irons, arranged in order of the per cent of nickel. No further attempt at classification is made. While Wadsworth's list is fairly complete as regards older analyses, it includes several pseudo-meteorites, and obviously does not adequately represent present knowledge.

The first recorded attempt at analysis of an iron meteorite is probably to be found in the examination in 1802, by Count de Bournon,‡ of some so-called native irons from Bohemia, Senegal, and South America. In these Count de Bournon found percentages of nickel ranging from five to ten per cent, but it is stated by Howard elsewhere in the paper that owing to lack of knowledge of the peculiarities of nickel these figures are little more than estimates. The next year Klaproth § reported one and one-half to three and one-half per cent of nickel in the iron meteorite of Hraschina, and expressed the opinion that the presence of nickel might serve as a criterion for

* Meteoritenkunde, Heft III.

† The Rocks of the Cordilleras, Memoirs Museum Comparative Zoölogy, Cambridge, Mass., Vol. XI, Part I, pp. vi-xvi, Table II.

‡ Phil. Trans. Roy. Soc., London, 1802.

§ Abhandl. Akad. Wiss., Berlin, 1803, 21-41.

judging the meteoric origin of a body. Cobalt was reported by Stromeyer in the iron meteorite of Cape of Good Hope in 1816,* and copper by the same investigator in 1833.† Stromeyer expressed the belief that copper was, with cobalt, a constant ingredient of meteoric nickel-iron, and this conclusion was later corroborated by Smith‡ on the basis of more than one hundred analyses. Chromium was discovered as a component of meteoric nickel-iron by Laugier in 1817.§ The presence of manganese and tin in meteoric nickel-iron was also early reported. The presence of other metals or semi-metals reported at different times, such as zinc, lead, arsenic, and antimony, has not been confirmed, while the presence of aluminum, calcium, magnesium, potassium, and sodium, noted by several analysts, is doubtless to be referred to small quantities of silicates which either formed a constituent of the meteorite, as in Tucson, Tula, etc., or accidentally contaminated the material analyzed. The occurrence of phosphorus in meteoric nickel-iron seems first to have been noted by Berzelius ‖ in the undissolved residue of Bohumilitz. It was similarily reported by analysts who followed Berzelius, but percentages were not commonly given until later times. Sulphur was early noted as an ingredient of meteoric stones and later of irons. Since it occurred as a soluble constituent, it was more often reported in the early analyses than phosphorus. The presence of carbon as graphite was noted by Tennant¶ in 1806 in the Cape of Good Hope meteorite. Being, like the phosphides, insoluble, its presence was often later reported in insoluble residues, but its amount was rarely given. Silicon, as reported in the earlier analyses, whether as metal or oxide, is probably for the most part to be referred to accessory silicates. With later methods, however, its detection in small quantities as an ingredient of the nickel-iron has become possible. The first detection of chlorine as an essential constituent of iron meteorites seems to have been by Jackson in 1838,** in the meteorite of Limestone Creek. Its presence has been occasionally but not commonly reported by later analysts. Determinations of specific gravity of the iron meteorites examined seem to have been common. While these are probably for the most part fairly reliable, some of the values reported are too anomalous to seem trustworthy.

* Gottingische Gelehrte Anzeigen, 1816, 2041–2043.
† Gottingische Gelehrte Anzeigen, 1833, 369–370.
‡ Am. Jour. Science, 1870 (2), 49, 332.
§ Ann. Chem. Pharm., 1817, IV, 363–366.
‖ Pogg. Ann., 1832, XXVII, 128–132.
¶ Tillochs Phil. Mag., London, 1806, XXV, 182.
** Am. Jour. Science (1), 34, 332–337.

IRON METEORITES.

These are meteorites consisting essentially of nickel-iron. Most of them contain, in addition, an appreciable amount of sulphides, carbides, and phosphides, but the presence of silicates in quantity removes a meteorite from this class. The iron meteorite of Tucson contains about five per cent of forsterite, and the meteorites of Kodaikanal, Persimmon Creek, and Tula also contain silicate aggregates, but in small quantities. In general, it may be said that if the quantity of silicate grains exceeds five per cent the meteorite is not considered as belonging to the class of iron meteorites. About two hundred and fifty iron meteorites are now recognized, the exact number being indeterminate on account of differences of opinion as to identity of origin in several cases. The chief divisions of iron meteorites, according to the Rose-Tschermak-Brezina classification, are hexahedrites, octahedrites, and ataxites. These are sub-divided as follows:

CLASSIFICATION OF IRON METEORITES ACCORDING TO ROSE, TSCHERMAK, BREZINA, AND COHEN

I. Hexahedrites.
- A. Normal hexahedrites.
- B. Brecciated hexahedrites.

II. Octahedrites.
- A. Normal octahedrites.
  1. Coarsest octahedrites.
  2. Coarse octahedrites.
  3. Medium octahedrites.
  4. Fine octahedrites.
     - *a.* Prambanan group.
     - *b.* Rodeo group.
  5. Finest octahedrites.
     - *a.* Salt River group.
     - *b.* Tazewell group.
     - *c.* Cowra and Victoria West.
- B. Hammond octahedrites.
- C. Brecciated octahedrites.

III. Ataxites.
- A. Nickel-poor ataxites.
  1. Siratik group.
  2. Nedagolla group.
  3. Rafruti group.

B. Nickel-rich ataxites.
   1. Smithland group.
   2. Cristobal group.
   3. Octibbeha.
C. Ataxites with forsterite.
D. Ataxites with cubic streaks.

The iron meteorites enumerated according to groups sum up as follows:

Octahedrites:	
Coarsest	13
Coarse	30
Medium	98
Fine	33
Finest	14
Brecciated	6
Hammond	3
Unclassified	4
	201
Ataxites	30
Hexahedrites	17
Total	248

ALPHABETICAL LIST OF IRON METEORITES.

The following is an alphabetical list of iron meteorites, showing the classification of each. An asterisk indicates that no analysis of the meteorite is reported.

Abert Iron	Medium octahedrite
*Adargas	Medium octahedrite
Algoma	Medium octahedrite
Alt Biela	Fine octahedrite
*Amates	Medium octahedrite
Angara	Medium octahedrite
*Apoala	Fine octahedrite
Arispe	Coarsest octahedrite
Arlington	Medium octahedrite
Asheville	Medium octahedrite
Auburn	Hexahedrite
Augustinowka	Fine octahedrite
Babb's Mill	Ataxite
Bacubirito	Finest octahedrite
Bald Eagle	Medium octahedrite
Ballinoo	Finest octahedrite
Barranca Blanca	Brecciated octahedrite
Beaconsfield	Coarse octahedrite
Bear Creek	Fine octahedrite
Bella Roca	Fine octahedrite
Bendego	Coarse octahedrite
Bethany	Fine octahedrite
Billings	Coarse octahedrite
Bingera	Hexahedrite
Bischtube	Coarse octahedrite
Black Mountain	Coarse octahedrite
*Blue Tier	Medium octahedrite
Bohumilitz	Coarse octahedrite

Boogaldi	Fine octahedrite
Botetourt	Ataxite
Braunau	Hexahedrite
Bridgewater	Fine octahedrite
Buckeberg	Fine octahedrite
Burlington	Medium octahedrite
Butler	Finest octahedrite
Cabin Creek	Medium octahedrite
Cacaria	Hammond octahedrite
Cachiyuyal	Medium octahedrite
Cambria	Fine octahedrite
Campo del Cielo	Ataxite
Canton	Coarsest octahedrite
Canyon Diablo	Coarsest octahedrite
Canyon City	Coarse octahedrite
Cape of Good Hope	Ataxite
Caperr	Medium octahedrite
Cape York	Medium octahedrite
Carlton	Finest octahedrite
Carthage	Medium octahedrite
Casas Grandes	Medium octahedrite
*Casey County	Coarsest octahedrite
Central Missouri	Coarsest octahedrite
*Chañaral	Coarse octahedrite
*Charcas	Medium octahedrite
*Chambord	
Charlotte	Fine octahedrite
Chesterville	Ataxite
*Chichimeguilas	
Chilkoot	Medium octahedrite
Chulafinnee	Medium octahedrite
Chupaderos	Fine octahedrite
Cincinnati	Ataxite
Cleveland	Medium octahedrite
Coahuila	Hexahedrite
Colfax	Medium octahedrite
Coopertown	Medium octahedrite
Cosby Creek	Coarse octahedrite
Costilla	Medium octahedrite
Cowra	Finest octahedrite
*Cranberry Plains	Octahedrite
Cranbourne	Coarse octahedrite
Cuba	Medium octahedrite
Cuernavaca	Fine octahedrite
Dalton	Medium octahedrite
Deep Springs	Ataxite
Dehesa	Ataxite
*Dellys	Medium octahedrite
Denton County	Medium octahedrite
Descubridora	Medium octahedrite
De Sotoville	Hexahedrite
Duell Hill	Coarse octahedrite
Elbogen	Medium octahedrite
El Capitan	Medium octahedrite
*El Tule	Medium octahedrite
*Emmitsburg	Medium octahedrite
Forsyth County	Ataxite
Fort Duncan	Hexahedrite
Fort Pierre	Medium octahedrite
Franceville	Medium octahedrite
Frankfort	Medium octahedrite
Glorieta	Medium octahedrite
Grand Rapids	Fine octahedrite
Greenbrier County	Coarse octahedrite
Groslee	Fine octahedrite
Guilford County	Medium octahedrite
Hammond	Hammond octahedrite
*Haniel el-Beguel	Medium octahedrite
Hassi Jekna	Fine octahedrite
*Hayden Creek	Medium octahedrite
Hex River	Hexahedrite
Holland's Store	Hexahedrite
Hopewell Mounds	Medium octahedrite
Hopper	Medium octahedrite
Hraschina	Medium octahedrite
*Ilimae	Medium octahedrite
Illinois Gulch	Ataxite
Indian Valley	Hexahedrite
Iquique	Ataxite
Iredell	Hexahedrite
Ivanpah	Medium octahedrite
*Jackson County	Medium octahedrite
Jamestown	Fine octahedrite
Jennie's Creek	Coarse octahedrite
Jewel Hill	Fine octahedrite
Joel's Iron	Medium octahedrite
Joe Wright	Medium octahedrite
Jonesboro	Fine octahedrite
Juncal	Medium octahedrite
Kendall County	Hexahedrite
Kenton County	Mediumoctahedrite

*Kodaikanal	Fine octahedrite
Kokomo	Ataxite
Kokstad	Medium octahedrite
La Caille	Medium octahedrite
Lagrange	Fine octahedrite
Laurens County	Finest octahedrite
Lenarto	Medium octahedrite
Lexington County	Coarse octahedrite
Lick Creek	Hexahedrite
Limestone Creek	Ataxite
Linville	Ataxite
Locust Grove	Ataxite
*Lonaconing	Coarse octahedrite
Losttown	Medium octahedrite
*Lucky Hill	Medium octahedrite
Luis Lopez	Medium octahedrite
*Madoc	Fine octahedrite
Magura	Coarse octahedrite
Mantos Blancos	Finest octahedrite
Marshall County	Medium octahedrite
Mart	Finest octahedrite
Matatiela	Medium octahedrite
Mazapil	Medium octahedrite
Merceditas	Medium octahedrite
Misteca	Medium octahedrite
*Moctezuma	Medium octahedrite
*Mooranoppin	Coarsest octahedrite
Moonbi	Fine octahedrite
Morito	Medium octahedrite
Morradal	Ataxite
Mount Joy	Hexahedrite
*Mount Stirling	Coarse octahedrite
Mungindi	Finest octahedrite
Murfreesboro	Medium octahedrite
Murphy	Hexahedtite
*Nagy-Vazsony	Medium octahedrite
Narraburra Creek	Finest octahedrite
Nedagolla	Ataxite
Nejed	Medium octahedrite
Nelson County	Coarsest octahedrite
Nenntmannsdorf	Ataxite
N'Goureyma	Brecciated octahedrite
Niagara	Coarse octahedrite
*Nochtuisk	Coarse octahedrite
*Nocoleche	Medium octahedrite
Oktibbeha County	Ataxite
Orange River	Medium octahedrite
*Oroville	Medium octahedrite
Oscuro Mountains	Coarse octahedrite
Pan de Azucar	Coarse octahedrite
*Persimmon Creek	Brecciated octahedrite
Petropawlowsk	Medium octahedrite
Pittsburg	Coarsest octahedrite
Plymouth	Medium octahedrite
Ponca Creek	Coarsest octahedrite
Prambanan	Fine octahedrite
Primitiva	Ataxite
Puquois	Medium octahedrite
Putnam County	Fine octahedrite
Quesa	Fine octahedrite
Rafruti	Ataxite
*Rancho de la Pila	Medium octahedrite
Rasgata	Ataxite
Red River	Medium octahedrite
Reed City	Hammond octahedrite
Rhine Valley	Medium octahedrite
Rodeo	Fine octahedrite
Roebourne	Medium octahedrite
*Rosario	Octahedrite
Rowton	Medium octahedrite
Ruff's Mountain	Medium octahedrite
Russel Gulch	Fine octahedrite
Sacramento Mountains	Medium octahedrite
St. Francois County	Coarse octahedrite
St. Genevieve County	Fine octahedrite
Salt River	Finest octahedrite
San Angelo	Medium octahedrite
San Cristobal	Ataxite
San Francisco del Mezquital	Ataxite
*Santa Apolonia	
Santa Rosa	Brecciated octahedrite
Sao Juliao	Coarsest octahedrite
Sarepta	Coarse octahedrite
Schwetz	Medium octahedrite
Scottsville	Hexahedrite
Seelasgen	Coarsest octahedrite
Seneca Falls	Medium octahedrite

Shingle Springs....Ataxite
*Sierra Blanca......Coarse octahedrite
Silver Crown ......Coarse octahedrite
Siratik.............Ataxite
Smithland ....Ataxite
Smith's Mountain..Fine octahedrite
Smithville ....Coarse octahedrite
Ssyromolotow......Medium octahedrite
Staunton ....Medium octahedrite
Summit............Hexahedrite
Surprise Springs...Medium octahedrite

Tabarz............Coarse octahedrite
*Tajgha............Medium octahedrite
*Tanogami.........Medium octahedrite
Tazewell...........Finest octahedrite
*Teocaltiche ....Octahedrite
Ternera...........Ataxite
Thunda ....Medium octahedrite
Thurlow...........Fine octahedrite
*Tlacotepec ....Octahedrite
Toluca ....Medium octahedrite
Tonganoxie ....Medium octahedrite
Toubil ....Medium octahedrite
Trenton...........Medium octahedrite
Tucson............Ataxite
Tula ....Brecciated octahedrite

*Union County......Coarsest octahedrite
Ute Pass ....Coarsest octahedrite

Varas ....Fine octahedrite
Victoria ....Medium octahedrite
Victoria West......Finest octahedrite

*Wallen's Ridge....Coarse octahedrite
Walker County.....Hexahedrite
Weaver ....Ataxite
Welland...........Medium octahedrite
*Werchne Dnieprowsk ....Finest octahedrite
Werchne Udinsk ..Medium octahedrite
Wichita County....Coarse octahedrite
Willamette ....Medium octahedrite
Wooster...........Medium octahedrite

Yanhuitlan.........Fine octahedrite
Yardea Station.....Medium octahedrite
*York..............Medium octahedrite
Youndegin ....Coarse octahedrite

Zacatecas..........Brecciated octahedrite

SYNONYMS.

The following are synonyms of the iron meteorites given in the preceding list:

Aeriotopos............Bear Creek
Agram...............Hraschina
Ainsa ....Tucson
Albuquerque ....Glorieta
Allen County.........Scottsville
Amakaken............Caperr
Arva.................Magura
Atacama, 1858........Joel's Iron
Atacama, 1874.......Cachiyuyal
Augusta County.......Staunton

Bahia ....Bendego
Baird's Farm.........Asheville
Bates County.........Butler
Batesville............Joe Wright
Bonanza ....Coahuila
Brazos River..........Wichita
Butcher Iron..........Coahuila

Caille ....La Caille
Caney Fork..........Carthage
Carleton Iron.........Tucson
Catorze ....Descubridora
Chatooga County......Holland's Store
Cherokee County, 1867.Losttown
Cherokee County, 1894.Canton
Chilkat...............Chilkoot
Claiborne............Lime Creek
Cocke County........Cosby Creek
Concepcion...........Adargas
Cross Timbers........Red River
Crow Creek..........Silver Crown

Dakota ....Ponca Creek

Ellenboro ....Colfax

Floyd County........Indian Valley

Floyd Mountain......Indian Valley

Great Fish River.....Bethany
Green County........Babb's Mill

Hamilton County.....Carlton
Hastings County......Madoc
Hauptmannsdorf.....Braunau
Henry County, 1857...Locust Grove
Henry County, 1889...Hopper
Honduras.............Rosario
Howard County......Kokomo

Independence County.Joe Wright
Independence........Kenton County
Iron Creek...........Victoria

Johnson County.......Cabin Creek

Knoxville............Tazewell

La Primitiva..........Primitiva
Lea Iron.............Cleveland
Lime Creek, 1832.....Walker County
Lime Creek, 1834.....Limestone Creek
Lion River...........Bethany
Lockport.............Cambria

Miller's Run.........Pittsburg
Muchachos...........Tucson

Mukerop.............Bethany

Netschaevo...........Tula

Obernkirchen.........Buckeberg
Oldham County.......La Grange

Penkarring Rock.....Youndegin

Ranchito.............Bacuburito

Saltillo...............Coahuila
Sanchez Estate........Coahuila
San Gregorio.........Morito
Saskatchewan........Victoria
Senegal..............Siratik
Serrania de Varas.....Varas
Sierra de la Ternera..Ternera
Southeast Missouri....St. Francois County

Teposcolula..........Yanhuitlan
Tocavita.............Santa Rosa
Tombigbee River.....De Sotoville
Tucuman............Campo del Cielo

Waldron's Ridge.....Wallen's Ridge
White Sulphur Springs............Greenbrier County
Whitfield County.....Dalton
Wohler's Iron........Campo del Cielo

ANALYSES OF IRON METEORITES.

I. HEXAHEDRITES.

The hexahedrites are characterized by cubic cleavage and Neumann lines. They consist of the single alloy kamacite, the composition of which, Fe_{14} Ni, shows a close approximation to the iron-nickel content of the hexadedrites. The content of phosphorus in the hexahedrites is usually relatively high, ¼ to ½ per cent. This appears char-

NORM

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellaneo
Auburn...........	94.58	3.01	.....	....	....	.13	......	.52	.....	.....	....	....
"	94.49	4.67	1.03	.101	.024	.46	.002	.....	.....	.....	....	....
Braunau..........	91.88	5.52	.53	....	....	......	......	.....	.....	.....	....	2.07
"	93.62	5.21	.92	.07	.05	.24	.08	.09	.....	.....	....	....
Coahuila..........	94.82	5.62	.60	....	tr.	.29	......	.....	.....	.....	.06	....
(Bonanza)..........	97.90	2.10	tr.	....	tr.	tr.	......	.....	.....	.....	....	Mg. tr.
(Butcher)............	92.95	6.62	.48	tr.	....	.02	......	.....	.....	.....	....	....
(Saltillo)............	94.62	4.79	.60	.04	tr.	.18	tr.	.....	.....	.....	....	....
(Santa Rosa).........	96.07	3.26	.55	....	....	1.05	......	.....	.....	.....	....	....
" "	91.86	7.42	.50	....	....	.27	......	.....	.....	.....	....	....
De Sotoville.......	95.02	4.11	.40	....	....	.32	tr.	.16	.....	.....	....	....
"	95.14	4.82		.05	.01	.29	.06	.....	.....	.....	....	....
"	95.18	4.32	.69	.04	....	.20	......	.07	.....	.....	....	....
"	95.41	4.04	.74	.04	....	.14	.05	.....	.....	.....	.02	....
Fort Duncan......	94.90	4.87		....	....	.23	tr.	tr.	.....	.....	....	....
" "	92.02	6.10		....	....	......	......	.....	.....	.....	1.80	....
" "	91.90	7.03		....	....	......	......	.....	.....	.....	....	....
" "	92.58	6.66	.73	....	....	.28	......	.....	.....	.....	.01	....
" "	94.65	4.82	1.07	.04	.04	.23	.32	.....	.....	.....	....	....
(Sancha)............	96.04	3.11	.42	....	....	......	......	.....	.....	.....	.57	....
"	95.82	3.18	.35	tr.	....	.24	......	.....	.....	.....	....	....

acteristically in the hexahedrites in the form of rhabdite, and often constitutes 1½ to 3 per cent of their mass. Another characteristic mineral of the hexahedrites is daubreelite. Graphite and troilite are rare, although the latter mineral occurs in some members of the group in visible nodules. The hexahedrites may be divided into normal and brecciated hexahedrites, according to whether they are one or several individuals.

A. NORMAL HEXAHEDRITES.

In these hexahedrites the cleavage planes and Neumann lines run without change of direction throughout the mass.

XAHEDRITES.

s	Undet.	Total.	Sp. Gr.	Analyst.	Reference.
..	......	98.24	7.-7.17	C. U. Shepard	1869, A. J. S. (2), XLVII, 230-233
.	......	100.77	....	O. Hildebrand......	1905, Meteoritenkunde, III, 217
..	......	100.00	7.782	Duflos & Fischer....	1847, Ann. Phy. Chem., LXXII, 475-480
..	.02	100.30	7.8516	R. Knauer..........	1905, Meteoritenkunde, III, 207
..	......	101.39	7.8678	E. Cohen...........	1894, Meteoreisen-Studien A. N. H., IX, 104
..	......	100.00	7.825	C. U. Shepard	1867, A. J. S. (2), XLIII, 385
..	......	100.07	7.692	J. L. Smith	1869, A. J. S. (2), XLVII, 385
..	......	100.22	....	O. Bürger..........	1905, Meteoritenkunde, III, 194
..	......	100.935	....	H. Wichelhaus......	1863, Ann. Phy. Chem., CXVIII, 631-634
..	......	100.05	....	N. F. Lupton.......	1885, A. J. S. (3), XXIX, 233
..	......	100.01	....	J. E. Whitfield......	1899, A. J. S. (4), VIII, 154
..	......	100.37	....	R. Knauer..........	1905, Meteoritenkunde, III, 213
..	......	100.50	....	Hildebrand & Cohen	Same
..	......	100.46	....	Knauer & Cohen....	Same
..	......	100.00	7.522	J. B. Mackintosh....	1886, A. J. S. (3), XXXII, 306
..	......	99.92	7.699	Meunier............	1887, C. R., CIV, 872-873
..	......	98.93	7.72	"	1893, B. S. H. N., VI, 17
..	......	100.26	....	E. Cohen...........	1889, Neues Jahrb., 227
..	.02	101.19	7.84	O. Hildebrand.....	1905, Meteoritenkunde, III, 194
..	......	100.14	8.13	F. A. Genth........	1854, A. J. S. (2), XVII, 239-240
..	......	99.59	7.81	J. L. Smith..........	1855, A. J. S. (2), XIX, 160-161

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellan
Hex River........	93.33	5.58	.84	....	....	......	......	....	....	....	....	....
" "	93.59	5.68	.66	.04	.02	.23	.08	....	....	....	.03	....
Iredell............	93.75	5.51	.52	....	....	.20	.06	....	....	....	....	....
Lick Creek........	93.00	5.74	.52	tr.	....	.36	tr.	....	....	tr.	....	....
Murphy...........	93.93	5.52	.61	.02	....	.34	......	.04	....	.06	....	....
Scottsville	94.32	5.01	tr.	....	....	.16	.34	.12	....	....	....	....
"	93.14	5.73	.99	.10	....	.15	......	....	....	....	.02	....
"	94.03	5.33	.95	.04	.02	.23	.07	....	....	....	.01	....
Walker County....	94.14	5.30	.64	.06	.05	.28	.19	....	....	....	....	....

B. BRECCIATED HEXAHEDRITES.

These hexahedrites are characterized by a structure which gives them the appearance of being aggregates of individual grains. Not only do apparent outlines of grains occur, but the directions of the Neumann lines are different on the different grains. The size of the grains differs in different falls, but is fairly uniform for meteorites of the same fall. The contour of the grains may be rounded, polygonal, elongated, or ragged, and as a rule the grains are sharply separated from one another. When the divisions between grains widen to a cleft, some accessory constituent usually occupies the gap. Accessory minerals are not, however, abundant. The presence of dau-

BRECCIA-

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellane
Bingera...........	93.76	4.39	.57	....	....	.23	......	.14	....	....	.54	Na. tr.
"	93.50	5.54	.51	.01	....	.26	......	.03	.01	....	....	Sn. .02 Mn. Pt.
Holland's Store....	93.06	5.35	1.00	....	.23	.31	.08	....	....	....	.08	....
" ...	94.60	4.97	.21	....	....	.21	tr.	tr.	....	....	....	....
Indian Valley......	93.59	5.56	.53	tr.	....	.27	.01	....	tr.	....	....	....
Kendall County...	92.65	5.64	.78	.03	.01	.34	.03	1.62	....	.01	....	....
Mount Joy	93.80	4.81	.51	.005	....	.19	.01	....	....	....	....	....
Summit...........	93.39	5.62	.58	....	....	.31	......	....	....	....	....	....

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
.94	100.69	....	Cohen & Weinschenk	1891, Meteoreisen-Studien A. N. H., VI, 143
......	100.43	7.8225	R. Knauer..........	1905, Meteoritenkunde, III, 225
......	100.04	....	J. E. Whitfield......	1899, A. J. S. (4), VIII, 415-416
......	99.62	....	Smith & Mackintosh	1880, A. J. S. (3), XX, 324-326
......	100.52	7.7642	J. Fahrenhorst	1900, Meteoreisen-Studien A.N.H., XV, 368
......	99.95	7.848	J. E. Whitfield......	1887, A. J. S. (3), XXXIII, 500
......	100.13	....	Fischer............	1889, Neues Jahrb., I, 227
......	100.68	7.7959	R. Knauer..........	1905, Meteoritenkunde, III, 220
......	100.66	7.7806	O. Hildebrand......	1905, Meteoritenkunde, III, 173

breelite has not been noted, and schreibersite is not common, either in nodules or as rhabdite. The view that the brecciated hexahedrites are aggregates is not accepted by Brezina, except in the case of Kendall County. He regards the structure and cleavage of the other members of the division as uniform, and explains the varying orientation as caused by twinning. Mount Joy, placed by Berwerth, Cohen, and Brezina among the coarsest octahedrites, because of an apparent octahedral structure observed by Berwerth, seems to the present writer to belong more properly to the hexahedrites. In composition and structure it agrees fully with the hexahedrites, and it shows no trace of cohenite, a characteristic mineral of the coarse octahedrites. Its individual grains are the largest of any of the following group:

XAHEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	99.63	7.834–7.849	A. Liversidge.......	1882, Proc. Roy. Soc. N. S. W., XVI, 31-34
......	99.88	7.761	J. C. H. Mingaye.....	1904, Rec. Geol. Sur. N. S. W., VII, 308-310
......	100.11	....	Zaubitzer	1905, Meteoritenkunde, III, 240
......	99.99	7.801	J. E. Whitfield......	1887, A. J. S. (3), XXXIV, 472
......	99.96	7.95	L. G. Eakins........	1892, A. J. S. (3), XLIII, 424
......	101.11	....	Scherer	1900, Meteoreisen-Studien, A. N. H., XV, 387
......	99.33	....	L. G. Eakins........	1892, A. J. S. (3), XLIV, 416
......	99.90	6.949	F. P. Venable.......	1890, A. J. S. (3), XL, 322

II. OCTAHEDRITES.

The meteorites of this class are the most abundant among iron meteorites. According to the width of the lamellæ as seen in etched sections, they are divided as follows: Coarsest octahedrites, lamellæ, many mm. to 2.5 mm. in width; coarse octahedrites, lamellæ 2–1.5 mm. in width; medium octahedrites, lamellæ 1.0–0.5 mm. in width; fine octahedrites, lamellæ 0.4–0.2 mm. in width; finest octahedrites, lamellæ from 0.2 mm. down. While no sharp line of separation can be drawn between these groups, the members of each group present as a rule characters more or less peculiar to themselves. As compared with the hexahedrites, the octahedrites differ in structure in being made up of lamellæ arranged in accordance with the planes of the octahedron. These lamellæ in turn are composed of two or more alloys of nickel-iron. In composition a higher percentage of nickel-cobalt may be noted among the octahedrites, as compared with the hexahedrites, and schreibersite and troilite are far more abundant than in the hexahedrites. Cohenite, which is not known to occur in the hexahedrites, is characteristic of certain groups of the octahe-

COAR

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	Insol.	Miscellane
Arispe	92.27	7.04	....	....	....	....	....	....	....	....	....	....
Canyon Diablo	95.370	3.945	....	....	....	.144	tr.	....	tr.	....	.26	....
" "	91.396	7.94	....	....	....	.179	.004	.417	.047	....	....	....
Canton	91.96	6.70	.50	.03	....	.11	.01	....	tr.	....	....	....
Central Missouri	94.73	4.62	.18	....	....	.44	.02	.01	....	....	....	....
Nelson County	93.10	6.11	.41	tr.	....	.05	....	....	....	....	....	....
Pittsburg	92.81	4.66	.39	.03	....	.25	.04	....	....	....	....	Mn......
"	93.38	5.89	1.24	.05	.02	.15	.07	....	....	....	....	Chromite
Ponca Creek	91.74	6.53	....	....	....	.01	....	....	....	....	....	Sn......
" "	91.74	7.08	....	....	....	.01	....	....	....	....	....	Sn......
São Julião	89.39	8.27		tr.	....	.26	....	....	....	....	....	....
Seeläsgen	90.00	5.31	.43	.10	....	....	....	....	1.16	....	.83	Mn......
"	92.33	6.23	.67	....	....	....	....	.52	.02	....	.18	Cu.+Sn.

drites, while graphite and diamond are also largely confined to the octahedrites. Daubreelite and chromite, which are common constituents of the hexahedrites, are rare in the octahedrites. The nickel-cobalt content of the octahedrites varies from 5½ to 15½ per cent.

A. NORMAL OCTAHEDRITES.

In the normal octahedrites the lamellar structure extends without change of direction, except for occasional curving, through the individual. This is true even for large masses like those of Charcas, Chupaderos, and Willamette.

1. COARSEST OCTAHEDRITES.

Width of lamellæ from many millimeters down to 2.5 mm. The nickel-cobalt content is as a rule slightly higher than in the hexahedrites, reaching in some cases 7 per cent. The presence of cohenite and graphite is characteristic of the group. Canyon Diablo contains diamond. The octahedral structure and presence of lamellæ is often difficult to discern, so that some members of the group have been classed as hexahedrites.

AHEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	99.31	7.853	J. E. Whitfield......	1902, Proc. Roch. Acad. Sci., IV, 85
......	99.719	7.703	H. Moissan.........	1904, Comptes Rendus, CXXXIX, 776
......	99.983	....	Booth, Garrett & Blair	1905, Proc. Phil. Aca. Sci., LVII, 875
......	99.31	....	H. N. Stokes........	1895, A. J. S. (3), L, 252-4
......	100.00	....	Mariner & Hoskins..	1900, A. J. S. (4), IX, 286
......	99.67	....	J. L. Smith..........	1860, A. J. S. (2), XXX, 240
......	98.32	7.74	F. A. Genth.........	1876, A. J. S. (3), XII, 72-73
......	100.87	....	O. Hildebrand	1903, Mitt. f. Neu Vorp. u. Rügen, XXXV, 4
......	98.34	7.952	C. T. Jackson.......	1863, A. J. S. (2), XXXVI, 261
......	98.89	7.952	" "	1863, A. J. S. (2), XXXVI, 261
......	97.92	7.783	C. v. Bonhorst	1888, Neues Jahrb., 372
......	98.74	7.63 –7.71	A. Duflos...........	1848, Ann. Phy. Chem., LXXIV, 61-65
......	100.00	7.73	C. Rammelsberg....	1848, Ann. Phy. Chem., LXXIV, 443-448

2. COARSE OCTAHEDRITES.

Width of lamellæ 2.0–1.5 mm. The lamellar or octahedral struc-

Co

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellar
Beaconsfield.......	92.56	7.34	.48	.02	....	.26	.04	.05	.....	.01	....	....
Bendego..........	91.90	5.71	....	....	....	.....	.....	....	....	.....	.46	....
"	88.46	8.59		....	....	.....	.....	.07	....	.....	....	P. Fe. N
Billings...........	91.99	7.38	.42	.01	....	.15	.06	.....	.08	....	....	....
Bischtübe.........	93.39	6.48	.87	.03	tr.	.05	.....	....	....	.....	.01	....
Black Mountain...	96.04	2.52	....	....	....	.....	.....	....	....	.....	1.44	....
Bohumilitz	94.06	4.01	....	....	....	.....	.81	....	....	.....	....	C. etc...
" 2/2	93.12	4.74	.23	....	....	.....	.....	....	....	.....	1.91	....
"	94.77	3.81	.20	....	....	.....	.....	....	....	.....	2.20	....
Canyon City.......	88.81	7.28	.17	....	....	.12	.....	.. ..	....	.....	....	....
" "	91.25	7.85	.17	....	....	.10	.....	....	....	.....	....	....
Cosby Creek......	87.00	12.00	....	....	....	.....	.....	.50	....	.....	....	....
" " 2/2	93.91	4.55	....	....	....	.....	.....	....	....	.....	.10	....
" "	91.64	5.85	.81	*.22	....	.19	.....	....	.08	.....	....	Mn.09 Grap
" "	91.90	6.70	.33	....	....	.09	.....	....	.18	.....	....	....
" "	92.75	6 91	.51	.02	....	.37	.....	....	....	.....	....	....
Duell Hill.........	94.24	5.17	.37	tr.	....	.14	.....	....	....	.....	.15	....
Greenbrier County.	91.59	7.11	.60	tr.	....	.08	.....	....	....	.....	....	....
Jennie's Creek	91.56	†8.31		....	....	.13	.....	....	....	.....	....	....
Lexington County..	92.42	6.08	.93	....	....	tr.	.....	....	....	.....	.26	Sn. tr...
Magura.........2/2	93.62	5.68	....	....	....	.....	.....	....	....	.....	....	....
"	89.42	8.61	....	....	....	.....	.....	....	....	.....	....	C. Cu. Si. Sch
" 2/2	90.91	7.32	....	....	....	.....	.....	....	....	.....	....	Co. C. Si., et
"	92.55	7.08	.51	.02	....	.24	.02	.03	.....	.01	....	....
Niagara...........	92.67	7.37	.13	....	....	.....	.....	....	....	.....	....	....
Oscuro Mountains..	90.79	7.66	.57	....	....	.27	.....	.07	....	.....	....	....

*Cu. Sn. †By diff.

ture is more obvious than in the coarsest octahedrites, and the nickel-cobalt content in some members slightly higher. Cohenite and graphite are characteristic and common ingredients.

AHEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	100.76	....	O. Sjöström.........	1897, Sitzber. Berl. Akad., 1047
......	100.00	7.73	Flickentscher.......	1863, Buchner, Meteorites, 144
......	99.45	7.47	Wohler & Martius ..	1867, Phipson, Meteorites, 94
......	100.09	....	H. W. Nichols......	1905, A. J. S. (4), XIX, 242
......	100.82	....	Scherer & Sjöstrom.	1897, Meteoreisen-Studien, V, A.N.H., XII, 55
......	100.00	7.261	C. U. Shepard......	1847, A. J. S. (2), IV, 81–83
......	100.00	7.15	J. Steinman.........	1830, A. J. S. (1), XIX, 384–386
......	100.00	....	J. J. Berzelius.......	1833, Ann. Phy. Chem., XXVII, 118–132
......	100.98	....	"	1853, A. J. S. (2), XV, 12
......	96.38	7.1	C. U. Shepard......	1885, A. J. S. (3), XXIX, 469
......	99.37	7.68	J. M. Davison.......	1904, A J. S. (4), XVII, 383
......	100.00	....	G. Troost...........	1840, A. J. S. (1), XXXVIII, 254
......	98.56	6.22	C. U. Shepard.......	1842, A. J. S. (1), XLIII, 354–357
......	99.68	....	C. A. Joy...........	1853, Ann. Chem. Pharm., LXXXVI, 39–43
......	99.20	7.26	C. Bergmann.......	1857, Ann. Phy. Chem., C, 254–255
......	100.56	....	J. Fahrenhorst	1900, Meteoreisen-Studien, XI, A.N.H. XV, 373
......	100.07	7.46	B. S. Burton........	1876, A. J. S. (3), XII, 439
.12	99.50	....	L. Fletcher.........	1887, Min. Mag., VII, 183
......	100.00	7.344	J. B. Mackintosh....	1886, A. J. S. (3), XXXI, 147
......	99.69	7.00–7.405	C. U. Shepard, Jr ...	1881, A. J. S. (3), XXI, 119
......	99.30	7.814	A. Patera...........	1847, Östr. Blätt. f. Lit., No. 169,–670
......	99.44	7.814	"	Same
......	99.30	7.01–7.22	A. Löwe...........	1849, Neues Jahrb., 199
......	100.46	....	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A.N.H. XV, 378
......	100.07	7.12	J. M. Davison.......	1902, Jour. Geol., X, 518-519
......	99.36	....	R. C. Hills.........	1897, Proc. Colorado Sci. Soc.

Name.	Fe.	Ni.	Co.	Cu	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellane
St. Francois County	92.10	2.60	tr.	....	....	tr.	....	tr.	tr.	....	....	Schreibersite .
" " "	92.68	6.97	.52	.02	....	.34	.01	....	....	.03	.01	....
Sarepta....	95.94	2.66	....	....	....	....	....	....	.02	....	....	Sn.02 P.Fe.Ni.
Silver Crown....	91.57	8.31	tr.	....	....	.07	....	tr.	....	....	....	....
Smithville....	91.57	7.02	.62	tr.	....	.18	....	....	....	....	....	Res. Mainly Car
Tabarz....	92.76	5.69	.79	....	....	.86	....	....	....	....	....	P. Fe. Ni.
Wichita....	89.99	10.01	tr.	....	....	....	....	....	....	....	....	....
Willamette....	91.46	8.30	....	....	....	....	....	....	....	....	....	....
"	91.65	7.88	.21	....	....	.09	....	....	....	....	....	....
Youndegin....	92.67	6.46	.55	tr.	....	.24	....	....	....	....	.04	Mg....

3. MEDIUM OCTAHEDRITES.

Width of lamellæ 1.0-0.5 mm. More than one-third of the iron meteorites belong to this class. They present, as a rule, quite uniform characters. The lamellar structure is, as a rule, well-defined, and

MED

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellane
Abert Iron....	92.92	6.07	.54	....	....	....	....	....	....	....	....	Schreibersite.
"	92.04	7.00	.68	....	....	.08	.01	.02	....	....	....	Graphite.
Algoma	88.62	10.63	.84	....	....	.15	tr.	....	.02	....	....	....
Angara....	92.64	7.10	....	....	....	.16	....	tr.	.04	....	tr.	Ca. tr. Mg
Arlington....	90.78	8.60	1.02	tr.	tr.	.05	....	tr.	....	....	....	....
Asheville	96.50	2.60	....	....	....	....	....	....	.50	.20	....	....
Bald Eagle	91.36	7.56	.70	....	....	.09	.06	....	tr.	....	....	....
Burlington....	92.29	8.14	....	....	....	....	....	....	....	....	....	....
"	95.20	2.13	....	....	....	....	....	....	....	....	.50	S. & loss.
"	89.75	8.90	.62	tr.	....	....	....	....	....	....	.70	Mn. tr.
Cabin Creek....	91.87	6.60	tr.	....	....	.41	.05	Comb'nd .15	....	tr.	.34	....
Cachiyuyal	93.92	4.93	.39	....	....	.08	....	....	.20	....	....	Ca. Mg..

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	99.70	7.02–7.11	C. U. Shepard	1869, A. J. S. (2), XLVII, 233 234
......	100.58	7.746	J. Fahrenhorst	1900, Meteoreisen-Studien, XI, A.N.H. XV, 371
......	99.96	....	J. Auerbach.........	1864, Sitz. Wien Akad., XLIX (2), 497
......	99.95	7.63	H. L. McIlwain.....	1888, A. J. S. (3), XXXVI, 277
......	99.54	....	O. W. Huntington...	1894, Proc. Am. Acad. Arts & Sci., XXIX, 253
......	100.38	7.74	W. Eberhard.......	1855, Ann. Chem. Pharm., XCVI, 286-289
......	100.00	....	W. P. Riddell.......	1860, Trans. St. Louis Acad. (1), 623
......	99.76	....	J. E. Whitfield......	1904, Proc. Rochester Acad. Sci., IV, 148
......	99.83	7.7	J. M. Davison.......	Same
......	100.38	....	L, Fletcher.........	1887, Min. Mag., VII, 125

the three alloys—kamacite, taenite, and plessite—are usually present. Among accessory constituents, troilite and schreibersite predominate. These are often in the form of nodules of appreciable size.

'AHEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	100.09	7.589	C. U. Shepard, Jr....	1876, A. J. S. (3), XII, 119
......	99.86	7.89	R. B. Riggs	1887, Bull. U. S. Geol. Sur. VIII, 94 97
......	100.26	7.75	A. A. Koch.........	1903, Bull. Geol. Soc. Amer. XIV, 104
......	100.00	....	M. A. Gobel	1874, Bull. St. Petersburg Akad. XIX, 544-54
......	100.45	....	F. F. Sharpless	1896, Amer. Geol. XVIII, 270
......	99.80	6.50–7.50	C. U. Shepard	1839, A. J. S. (1), XXXVI, 81-84
......	99.77	7.06	W. G. Owens.......	1892, A. J. S. (3), XLIII, 423–424
......	100.43	....	C. H. Rockwell	1844, A. J. S. (1), XLVI, 402
......	100.00	....	C. U. Shepard......	1847, A. J. S. (2), IV, 77–78
......	99.97	7.72	W. S. Clark	1852, Metallic Meteorites, 61-62
......	99.42	7.837	J. E. Whitfield......	1887, A. J. S. (3), XXXIII, 500
......	99.82	....	J. Domeyko	1875, Comptes Rendus, LXXXI, 597

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscellan
Caperr	89.87	9.33	.53	tr.	tr.	.24	....	....	....	....	....	....
Cape York	90.14	8.18	.54	....	....	.18	.19	.15	....	....	....	....
" 3/3	91.31	7.94	.53	.02	....	.19	.01	.04	....	....	....	....
Carthage	89.47	7.72	.25	....	....	.09	.40	....	.60	tr.	....	1.1
Casas Grandes....	95.13	4.38	.27	tr.	....	.24	....	tr.	....	....	....	....
"	92.66	7.26	.94	...	.03	.18	.02	....	....	....	....	Chromite
Chilkoot	92.56	7.11	.12	tr.	....	.12	.04	tr.	....	....	....	....
Chulafinnee.......	91.61	7.37	.50	....	....	.17	....	....	....	....	....	....
Cleveland....... 3/3	89.59	8.79	.67	.12	....	.32	.006	....	....	....	....	....
Colfax 2/2	88.45	10.31	.57	.04	....	.19	.09	....	.02	....	....	....
"	88.05	10.37	.68	.04	....	.21	.08	....	.02	....	....	....
Coopertown	89.59	9.12	.35	tr.	....	.04	....	....	....	....	....	....
Costilla	91.65	7.71	.44	....	....	.10	High. .26	....	....	....	....	....
Dalton	94.66	4.80	.34	....	tr.	tr.	....	....	....	....	....	Mn. tr.
Denton County....	94.02	5.43	tr.	....	....	....	....	....	....	....	.33	....
"	92.10	7.53	tr.	....	....	.001	....	....	....	....	....	....
Descubridora	89.51	8.05	1.94	....	....	....	.45	....	....	....	....	P.Cr. and los
"	90.09	9.07		.24	....	....	....	....	....	....	.66	....
Elbogen	97.50	2.50	....	....	....	....	....	....	....	....	....	....
"	87.50	8.75	....	....	tr.	....	....	....	....	....	....	Mn. tr.
"	88.23	8.52	1.85	....	....	....	tr.	....	....	....	....	P. Fe. Ni. Mg.28, M
"	89.90	8.43	.76	....	....	....	....	....	....	....	....	....
"	94.69	2.47	.61	....	.12	....	....	....	....	....	....	Al. 19, Mr
El Capitan........	90.51	8.40	1.59	.05	....	.24	tr.	....	....	....	....	....
Fort Pierre	94.29	7.19	.60	....	....	....	tr.	....	....	....	....	Ca. 35, Mg.
"	90.76	7.61	.89	tr.	....	tr.	....	....	....	....	.05	....
Franceville	91.10	8.06		....	....	....	....	....	tr.	....	....	*Pt. tr.
Frankfort	90.58	8.53	.36	tr.	....	.05	....	....	....	....	....	....
Glorieta	88.76	9.86	.51	.03	....	.18	.01	....	.04	....	....	Zn. .03, M

*Schreibersite, .84; Graphite, tr.; Silicate, tr.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	99.97	7.86	L. Fletcher.........	1899, Min. Mag. XII, 167–170
......	99.38	....	J. K. Phelps	1898, Northward Over the Great Ice, (2) 600
......	100.04	....	J. E. Whitfield.....	" " " " 602
......	99.72	7.48–7.50	E. Boricky	1866, Neues Jahrb, 808–810
......	100.02	....	W. Tassin..........	1902, Proc. U. S. Nat. Mus. XXV, 71
......	101.12	7.885	Cohen & Hildebrand	1903, Mitt. Nat. Ver. f. Neuvorp. u. Rügen, XXXV, 13
......	100.00	7.76	....	1905, Label, State Mining Bureau Collection, San Francisco, California
......	99.65	....	J. B. Mackintosh....	1880, A. J. S. (3), XX, 74
......	99.496	7.521	F. A. Genth	1886, Proc. Phila. Acad. Sci. 366–368
......	99.67	....	S. W. Cramer	1890, Trans. N. Y. Acad. Sci. IX, 197–198
......	99.45	....	L. G. Eakins	1890, A. J. S. (3), XXXIX, 395–396
......	99.10	7.85	J. L. Smith	1861, A. J. S. (2) XXXI, 266
......	100.16	....	L. G. Eakins	1895, Proc. Colo. Sci. Soc.
......	99.80	7.986	C. U. Shepard, Jr...	1883, A. J. S. (3), XXVI, 338
......	99.78	7.67	W. P. Riddell.......	1860, Trans. St. Louis Acad. I, 623
......	99.63	7.42	A. Madelung.......	1863, Buchner, Meteoriten, 193
......	100.00	7.38	P. Murphy	1875, Neues Jahrb, 26
......	100.00	7.609	J. B. Mackintosh....	1887, A. J. S. (3), XXXIII, 235
......	100.00	7.80–7.83	M. H. Klaproth.....	1815, Beit. Mineralkörper, VI, 306–308
......	98.10	7.76	J. F. John	1821, Jour. Chem. Phys. XXXII, 253–261
......	100.00	7.74–7.87	J. J. Berzelius.......	1834, Ann. Phys. Chem. XXXIII, 135–137
......	99.00	7.78	A. Wehrle	1863, Buchner, Meteoriten, 151–152
......	99.94	....	P. A. v. Holger	" " " "
......	99.80	....	H. N. Stokes	1895, A. J. S. (3), I, 252–254
......	102.48	7.73	H. A. Prout.........	1860, Trans. St. Louis Acad. I, 711–712
......	99.31	7.74	A. Madelung	1863, Buchner, Meteoriten, 197
......	100.00	7.87	J. M. Davison	1902, Proc. Roch. Aca. Sci. IV, 75–78
......	99.52	7.69	J. L. Smith	1870, A. J. S. (2), XLIX, 331
......	99.42	....	L. G. Eakins	1885, Proc. Colo. Sci. Soc. II, 14

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	Insol.	Miscella
Glorieta	88.81	7.28	.17	....	....	.12	.....	.....	.....	.....	....	....
"	87.93	11.15	33	....	....	.36	.....	.....	.....	.....	....	....
Guilford County ..	92.75	3.15	tr.	....	....	.....	.....	.....	.....	.....	....	Fe_2O_3 + Fe
Hopewell Mounds.	95.20	4.64	.40	.04	....	.07	.13	.....	.....	.....	....	Mn. tr.,
Hopper	90.54	7.70	.94	....	....	.13	.....	.....	.04	.35	....	....
Hraschina	96.50	3.50	.....	....	....	.....	.....	.....	.....	.....	....	....
"	83.29	11.84	1.26	....	....	.....	.....	.....	.68	....	....	Mn. .64, K. .43, A
"	89.78	8.88	.67	....	....	.....	.....	.....	.....	.....	....	....
Ivanpah	94.98	4.52	.....	....	....	.07	.....	.10	.....	.....	....	....
Joel's Iron	90.45	8.80	.54	tr.	....	.26	.....	tr.	.....	.....	....	....
Joe Wright	91.22	8.62*		....	....	.16	.....	.....	.....	.....	....	....
Juncal	92.03	7.00	.62	....	....	.21	.....	.....	.....	.....	....	....
Kenton County....	91.59	7.65	.84	tr.	....	tr.	tr.	.12	.....	.....	....	....
Kokstad	91.21	8.01	.63	.02	....	.22	tr.	.03	.....	.05	....	....
La Caille........2/2	92.50	5.90	tr.	....	tr.	.....	.....	.....	.90	.....	....	....
" 2/2	89.63	9.83	.....	....	....	.....	.....	.12	.....	.....	....	Insol. & lo
Lenarto	85.04	8.12	3.59	....	....	.....	.....	.....	.01	.....	....	Ca. 1.63, Al Mn. .61, M
"	90.90	8.50	.665	.002	....	.....	.....	.....	.....	.....	....	....
"	90.15	6.55	.50	.08	....	.....	.48	.....	.....	.....	1.23	Mn .15,
"	90.88	8.45	.67	....	....	.....	.....	.....	.....	.....	....	....
"	91.50	8.58	.....	tr.	....	.....	.....	.....	.....	.....	.30	....
Losttown	95.76	3.66	tr.	....	tr.	.....	.....	.....	.....	.....	.58	Ca. tr.
Luis Lopez	91.31	8.17	.16	....	....	.33	.01	.01	tr.	.....	....	....
Marshall County ..	90.12	8.72	.32	tr.	....	.10	.....	.....	.....	.....	....	....
Matatiela	92.20	7.30	.67	.03	....	.19	.03	.08	.....	.03	....	....
Mazapil	91.26	7.84	.65	....	....	.30	.....	.....	.....	.....	....	....
Merceditas	92.38	7.33	.61	.02	....	.08	.07	.....	.....	.....	.02	....
Misteca...........	86.86	9.92	.74	....	....	.07	.55	.....	.....	.....	.97	....
Morito	95.01	4.22	.51	tr.	....	.08	....	.....	.....	.....	....	....

By diff.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
.....	96.38	7.1	C. U. Shepard	1885, A. J. S. (3), XXIX, 469
.....	99.77	7.66	J. B. Mackintosh....	1885, A. J. S. (3), XXX, 238
.....	96.65	7.67	C. U. Shepard	1841, A. J. S. (1), XL, 369-370
.....	100.48	....	H. W. Nichols......	1902, Field Col. Mus. Pub. Geol. Ser. I, 308
.....	99.70	....	F. P. Venable	1890, A. J. S. (3), XL, 163
.....	100.00	7.73-7.80	M. H. Klaproth.....	1807, Beit. Mineralkörper, IV, 99-101
.....	100.00	7.82	P. A. v. Holger	1830, Beit. u. vor. Ett. Zeit. f. Phys. u. Math. VII, 2, 129-149
.....	99.33	7.785	A. Wehrle	1852, Clark, Metallic Meteorites, 42-44
.....	99.67	7.65	C. U. Shepard......	1880, A. J. S. (3), XIX, 381-382
.....	100.05	7.863-7.958	L. Fletcher.........	1889, Min. Mag. VIII, 264
.....	100.00	....	J. B. Mackintosh....	1886, A. J. S. (3), XXXI, 462
.....	99.86	....	A. A. Damour	1868, Comptes Rendus, LXVI, 569-571
.....	100.20	....	J. M. Davison	1892, A. J. S. (3), XLIV, 164
.....	100.17	7.7876	Fahrenhorst........	1900, Ann. S. Afr. Mus. II, 14
.....	99.30	7.43	L. E. Rivot	1854, Ann. Mines (5), VI, 554-555
.....	100.00	7.64	J. Boussingault	1872, Comptes Rendus, LXXIV, 1287-1289
.....	100.00	....	P. A. v. Holger	1830, Beit, u. Ett. Zeit, f. Phys. u. Math. VII, 2, 129-149
.....	100.067	7.79	A. Wehrle	1841, Rammelsberg, Handworterbuch, 423
.....	99.22	7.73	W. S. Clark	1852, Metallic Meteorites, 40
.....	100.00	7.98	A. Wehrle	" " " "
.....	100.38	7.73	J. Boussingault	1872, Comptes Rendus, LXXIV, 1288-1289
.....	100.00	....	C. U. Shepard	1869, A. J. S. (2), XLVII, 234
.....	99.99	....	Mariner & Hoskins .	1900, A. J. S. (4), IX, 284
.....	99.26	....	J. L. Smith.........	1860, A. J. S. (2), XXX, 240
.....	100.53	7.8084	J. Fahrenhorst......	1900, Ann. So. Afr. Mus. II, 17
.....	100.05	....	J. B. Mackintosh....	1887, A. J. S. (3), XXXIII, 225.
.....	100.51	....	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H. XV, 380
.....	99.11	7.58	C. Bergeman	1857, Pogg. Ann. C. 246
.....	99.82	7.84	J. L. Smith	1871, A. J. S. (3), II, 335-338

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell.
Murfreesboro	96.00	2.40	....	....	....	.....	.....	....	....	....	....	......
Nejed	91.04	7.40	.66	tr.	....	.10	tr.	....	....	....	....	......
Orange River.....	90.48	8.94		....	tr.	.....	.....	....	....	....	....	Chladni Schreib
Petropawlowsk....	97.29	2.07	....	....	....	.....	.....	....	....	....	....	......
" 2/2	93.57	6.98	....	....	....	.....	.....	....	....	....	....	......
Plymouth.........	88.67	8.55	.66	.24	....	1.25	.07	....	....	....	....	Graph.
Puquios	88.67	9.83	.71	.04	....	.17	.09	.04	tr.	....	....	......
Red River	90.02	9.67	....	....	....	.....	.....	....	....	....	....	......
"	90.91	8.46	....	....	....	.....	.....	....	....	....	.50	......
Rhine Valley	88.85	9.07	.34	....	....	.27	.75	....	....	....	....	......
Roebourne	90.91	8.33	.06	....	....	.16	tr.	tr.	.01	....	....	Mn. tr.
Rowton	91.05	9.08		tr.	....	.....	.....	....	....	....	....	......
"	91.25	8.58	.37	tr.	....	.....	.....	....	....	....	....	......
Ruff's Mountain...	96.00	3.12	....	....	....	.....	.....	....	....	....	....	......
"	90.95	6.01	tr.	....	tr.	.....	.....	....	....	....	2.35	Schreib
Sacramento Mts...	91.39	7.86	.52	....	....	.....	.....	....	....	....	....	......
San Angelo.......	91.96	7.86	tr.	.04	....	.10	.03	tr.	.01	....	....	Mn. tr.
Schwetz	93.18	5.77	1.05	....	....	.....	.....	....	....	....	.10	......
Seneca Falls......	92.40	7.60	....	....	tr.	tr.	fr.	....	....	....	....	Mg. tr. Mn. ?
Staunton	91.44	7.56	.61	.02	....	.07	.02	.14	.11	tr.	....	Sn. tr.
"	90.29	8.85	.49	.02	tr.	.24	.01	.18	.09	tr.	....	Sn..... Mn. tr.
" No. 1...	88.71	10.16	.40	.003	....	.34	.02	.17	.07	.003	....	Sn..... Mn. tr.
" No. 2...	88.36	10.24	.43	.003	....	.36	.008	.18	.06	.002	....	Sn.....
" No. 3...	89.01	9.96	.39	.003	....	.37	.03	.12	.06	.004	....	Sn..... Mn. tr
" No. 7...	89.85	7.56	.60	.06	....	.16	.01	.05	.05	.....	....	O.....
Surprise Springs ..	91.01	7.65	.89	.07	.04	.22	.08	.02	.....	.02	....	......
Thunda	91.54	8.49	.56	.02	tr.	.17	.02	....	....	....	.01	......
Toluca	91.38	8.62	....	....	....	.....	.....	....	....	....	....	......
"	90.40	5.02	.04	....	....	.16	.....	....	....	....	....	P. Fe. N Mn. tr.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
.60	100.00	....	G. Troost	1848, A. J. S. (2), V, 351–352
.59	99.79	7.89	L. Fletcher.........	1887, Min. Mag. VII, 179–182
....	100.00	7.3	C. U. Shepard	1856, A. J. S. (2), XXI, 213
....	99.36	7.76	Sokolowsky	1841, Arch. Kunde Russ. I, 317
....	100.55	....	Iwanow	1841, Arch. Kunde Russ. I, 723–725
....	99.55	....	J. M. Davison.......	1895, A. J. S. (3), XLIX, 53–55
....	99.55	7.93	L. G. Eakins	1890, A. J. S. (3), XL, 226
....	100.00	7.54	C. U. Shepard	1829, A. J. S. (1), XVI, 217–219
....	99.87	7.40–7.82	B. Silliman, Jr. & T. S. Hunt.	1846, A. J. S. (2), II, 372–374
....	99.31	....	W. S. Chapman	1900, Ann. Rep. So. Aust. Sch. Mines, 227–228
....	100.00	....	Mariner & Hoskins .	1898, A. J. S. (4), V, 136
....	100.13	....	W. Flight	1882, Phil. Trans. 894–896
....	100.20	....	"	" " "
....	99.121	7.01–7.10	C. U. Shepard	1850, Proc. A. A. A. S. III, 152–154
....	99.81	....	Boecking	1856, Neues Jahrbuch, 51
....	100.00	7.7	Mariner & Hoskins .	1898, A. J. S. (4), V, 272
....	99.77	....	J. E. Whitfield......	1897, A. J. S. (4), III, 66
....	100.10	7.77	C. Rammelsberg....	1851, Ann. Phys. Chem. LXXXIV, 153–154
....	100.00	....	C. U. Shepard	1853, A. J. S. (2), XV, 366
....	99.97	7.69	J. P. Santos.........	1878, A. J. S. (3), XV, 337–338
....	100.175	....	J. W. Mallet........	1887, A. J. S. (3), XXXIII, 59
....	99.878	7.85	"	1871, A. J. S. (3), II, 13
....	99.345	7.86	"	" " "
....	99.95	7.84	"	" " "
....	99.90	....	J. E. Whitfield......	1903, A. J. S. (4), XV, 469–471
....	100.00	7.7308	E. Cohen...........	1900, Mitt. Nat. Ver. f. Neu Vorp. u. Rügen, 32
....	100.81	....	J. Fahrenhorst	1900, Meteoreisen-Studien, XI, A. N. H. XV, 382
....	100.00	7.72	Berthier............	1853, A. J. S. (3), XV, 20
....	99.72	....	E. Uricoechea	1854, Jour. Prakt. Chem. LXIII, 317–318

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Misc
Toluca	90.37	7.79	....	....	....	......	......	....	....	.....	1.91	.....
"	90.72	8.49	.44	....	....	.18	......	.....	.25	.....	....	.....
"	87.88	8.86	.89	....	....	.86	......	.....	.....	.....	....	Grap
"	87.89	9.06	1.07	tr.	....	.62	......	.....	.....	.....	....	*C.G
"	88.29	8.90	1.04	....	....	.78	......	.....	.....	.....	....	.....
"	90.08	7.10	....	....	....	......	1.24	.....	.....	.....	....	.....
"	90.43	7.62	.72	....	....	.15	.03	.....	.....	.....	....	†Cu.
"	87.09	9.80	.77	.01	....	......	.79	.....	.....	.....	.02	Schre
"	89.07	7.29	.98	tr.	....	......	.85	.....	.....	.....	.04	Mn. Fe. S
"	90.13	7.24		....	....	.38	......	.....	.....	.....	.22	.....
"	91.89	6.32	1.58	....	....	......	......	.....	.....	.....	....	Mn. t
(Los Reyes)	90.56	7.71	1.07	.14	....	.24	.03	.01	.01	.....	....	Mn. t
Tonganoxie	91.18	7.93	.39	tr.	....	.10	......	.....	.....	.....	....	.....
Toubil	95.18	3.38	.14	....	....	.05	......	.12	.08	.04	....	Mn. .0 Mg. .0
Trenton	91.03	7.20	.53	tr.	....	.14	......	.....	.....	.....	.45	.....
"	89.22	10.79	tr.	....	....	.69	......	.....	.....	.....	....	.....
Victoria	91.33	8.83	.49	....	....	......	......	.....	.....	.....	....	.....
Welland	91.17	8.54	.06	....	....	......	.07	.....	.....	.....	....	.....
Werchne Udinsk..	91.02	7.31	.70	.13	....	.07	......	.03	.....	.....	....	Mg.. Fe. N
Wooster	93.61	6.01	.73	tr.	....	.13	......	.....	.....	.....	....	Mn. t

*P. Fe. Ni., .34; Mn., .20; Sn., tr.
†Graph., etc., .34; P., Fe., Ni., .56.

...det.	Total.	Sp. Gr.	Analyst.	Reference.
....	100.07	....	W. J. Taylor........	1856, Proc. Phil. Aca. Sci. VIII, 3
....	100.46	....	"	1856, A. J. S. (2), XXII, 374–376
....	98.73	....	E. Pugh............	1856, Ann. Chem. u. Pharm. XCVIII, 383-386
....	99.40	....	"	" " " "
....	99.00	....	"	" " " "
....	98.42	....	"	" " " "
....	99.88	....	"	" " " "
....	99.21	....	Boecking...........	Neues Jahrbuch, 304
....	99.20	....	"	" "
....	100.00	....	H. B. Nason........	1857, Jour. Prakt. Chem. LXXI, 123
....	99.79	....	C. H. L. v. Babo	1863, Buchner, Meteoriten, 141
....	99.85	....	H. W. Nichols......	1902, Pub. Field Col. Mus., Geol. Ser, I 308
....	99.60	7.45	E. H. S. Bailey	1891, A. J. S. (3), XLII, 386
....	99.34	....	J. Antipoff..........	1898, Bull. St. Petersburg Acad. Sci. V, 9, 91–103
....	99.35	7.82	J. L. Smith	1869, A. J. S. (2), XLVII, 271
....	100.70	7.33	G. Bode............	1869, Ann. Rep. Smith. Inst. 417–419
....	100.65	7.78	A. P. Coleman......	1887, Proc. and Trans. Roy. Soc. Can., IV, 97
....	99.84	7.87	J. M. Davison.......	1890, Proc. Roch. Acad. Sci. I, 87
....	99.41	....	H. Laspeyres.......	1895, Zeit. Kryst. XXIV, 494
....	100.48	7.90	J. L. Smith	1864, A. J. S. (2), XXXVIII, 385–386

4. FINE OCTAHEDRITES.

Width of lamellæ 0.4-0.2 mm. The nickel-cobalt content ranges between 8 and 10½ per cent. The fields are usually equal in amount to the lamellæ and contain minute shining flakes, probably of taenite.

a. PRAM

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Misce
Augustinowka	91.91	7.70	.25	....	....	......	......	....	....	....	....	.....
Bella Roca........	91.48	7.92	.22	....	....	.21	.21	.06	....	....	....	.....
"	89.68	9.78	.55	.02	tr.	.31	.05	....	....	....	....	.....
Bethany (Mukerop) ..	91.07	8.18	.63	.03	.02	.06	.04	.01	....	....	....	.....
" " .	92.29	7.77	.57	....	....	.06	......	....	....	....	....	Cu. C. Cr
" " ..	90.96	8.19	.46	.04	....	.18	tr.	.02	....	.01	.01	.....
" " ..	91.37	7.97	.50	.02	.04	.03	.02	.05	....	....	....	.....
" (Lion River)..	93.30	6.70	....	....	....	tr.	tr.	....	....	....	....	K_2O t
" " ..	92.06	7.79	.69	.03	.01	.05	.10	....	....	....	....	.....
Boogaldi	91.13	8.05	.48	.28	....	......	......	....	....	....	.04	.....
Bridgewater	88.90	9.94	.76	.35	....	......	......	....	....	.02	....	.....
Bückeberg........	90.95	8.01		....	....	.64	......	....	....	....	....	.....
"	92.45	7.55	.83	.02	.01	.12	.01	.01	....	.02	....	.....
Cambria 2/2	94.88	5.69	....	....	....	......	......	....	....	....	....	.....
"	92.58	5.71	....	tr.	....	......	......	....	....	....	1.40	As. tr.
"	89.06	10.65	.08	.04	....	......	.17	....	....	....	....	.....
Charlotte	91.15	8.01	.72	.06	....	......	......	....	....	....	....	.....
Chupaderos.......	90.23	8.76	1.21	....	....	tr.	......	....	....	....	....	.....
"	88.78	9.80	.81	.02	tr.	.13	.13	....	....	....	....	.....
Cuernavaca.......	88.98	10.30	....	....	....	......	......	....	....	....	....	.....
"	89.70	8.76	1.19	.05	....	.33	.12	....	....	....	....	.....
Grand Rapids.....	94.54	3.82	.40	....	....	......	......	....	....	....	.12	.....
"	88.71	10.69	....	.07	....	.26	.03	.06	....	....	....	Mg. .. Grapl
Hassi Jekna.......	91.32	5.88	.81	tr.	....	......	tr.	....	....	....	1.04	.....
Jamestown........	90.24	9.75	....	tr.	....	.05	......	....	....	....	....	.....

Cohen divides the fine octahedrites into two groups, the Prambanan group and the Rodeo group. The Prambanan group includes the greater number. They have a fairly uniform composition. Accessory constituents are usually present, but not in large quantity.

Undet.	Total.	Sp. Gr.	Analyst.	References.
.....	99.86	....	W. F. Alexejew	1893, Verh. Russ. Min. Ges. II, 30, 470
.....	100.10	....	J. E. Whitfield......	1889, A. J. S. (3), XXXVII, 440
.....	100.39	7.8244	Knauer	1905, Meteoritenkunde, III, 377
.....	100.04	7.8408	J. Fahrenhorst......	1900, Ann. S. Afr. Mus. II, 28
.....	100.79	7.8408	"	" " "
.....	99.89	....	O. Hildebrand......	1902, Jb. d. Ver. f. Vaterl. Naturk. Würtemberg, LVIII, 292–306
.....	100.00	7.783	Krupp Lab.........	1902, Jb. d. Ver. f. Vaterl. Naturk. Würtemberg, LVIII, 292–306
.....	100.00	7.45	C. U. Shepard......	1853, A. J. S. (2), XV, 1–4
.....	100.73	....	Sjöström & Fahrenhorst.	1897, Meteoreisen-Studien, V, A. N. H. XII, 43
.....	99.98	7.85	A. Liversidge.......	1902, Jour. Roy. Soc. N. S. W. XXXVI, 341–359
.....	99.97	6.617	F. P. Venable	1890, A. J. S. (3), XL, 312–313
.....	99.60	7.12	Wohler & Wicke...	1863, Göttingen Nach. 364-367
.....	101.01	....	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H. XV, 367
.....	100.57	7.52	D. Olmsted, Jr......	1845, A. J. S. (1), XLVIII, 388-392
.....	99.69	....	B. Silliman, Jr., & T. S. Hunt.	1846, A. J. S. (2), II, 374–376
.....	100.00	....	C. Rammelsberg ...	1870, Ber. Berl. Akad. 444
.....	99.94	7.717	J. L. Smith	1875, A. J. S. (3), X, 351
.....	100.20	....	Cohen & Weinschenk	1891, Meteoreisen-Studien, VI, A. N. H. VI, 147–148
tr.	99.67	....	O. Bürger..........	1905, Meteoritenkunde, III, 354
.....	99.28	7.725	J. E. Whitfield	1902, Proc. Roch. Aca. Sci. IV, 79–88
.....	100.15	7.748	O. Hildebrand......	1902, Mitt. d. Nat. Ver. f. Neu. Vorp. u. Rügen, XXXIV, 2
.....	98.88	....	F. W. Taylor.......	1884, A. J. S. (3), XXVIII, 300
.....	99.91	7.87	R. B. Riggs	1885, A. J. S. (3), XXX, 312
.....	99.05	7.67	S. Meunier.........	1892, Comptes Rendus, CXV, 531–533
.....	100.04	....	O. W. Huntington ..	1890, Proc. Am. Acad. (2), XVII, 229–232

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Misce
Jewel Hill	91.12	7.82	.43	tr.	....	.08	......	.....	.....	.....	....	......
Lagrange.........	91.21	7.81	.25	tr.	....	.05	......	.....	.....	.....	....	......
"	91.92	7.61	.62	.01	.02	.03	.02	.....	.....	.....	....	......
Mantos Blancos...	90.77	8.83	.55	tr.	....	.10	......	.....	.....	.....	....	......
Moonbi...........	91.35	7.89	.56	tr.	tr.	.22	......	.07	.04	.....	....	Sn. tr.
Prambanan	96.71	2.86	....	....	....	......	......	.....	.....	.....	....	......
"	94.36	5.37	....	....	....	......	......	.....	.....	.....	....	......
"	88.60	11.20	....	....	....	.20	......	.004	tr.	.....	....	MgO.
"	90.03	9.39	.97	....	....	.16	......	.....	.....	.....	....	......
"	94.38	4.70	....	....	....	.53	......	.....	.....	.....	....	......
Putnam County ...	89.52	8.82	tr.	....	....	......	......	.....	.....	.....	....	Sn. P. Ca....
" ...	90.28	7.89	.79	.07	.17	.11	.25	.....	.....	.....	....	......
Russel Gulch	90.61	7.84	.78	tr.	....	.02	......	.....	.....	.....	....	......
"	90.65	7.87	.01	....	....	......	......	.....	.....	.....	....	Insol.Si. Sn
St. Genevieve. ...	91.58	7.98	.29	....	....	.20	tr.	.....	.02	.....	....	......
Smith's Mountain..	90.68	9.07		.11	....	.14	......	.....	.....	.....	....	......
" ..	90.88	8.02	.50	.03	....	.03	......	.....	.....	.....	....	......
Thurlow	89.17	9.92	1.04	....	....	.25	.05	.....	.....	.....	....	Cu. &
Varas	91.28	8.00	.44	tr.	....	.05	......	.....	.....	.....	....	......
Yanhuitlan	96.58	1.83	....	....	....	......	......	tr.	.01	.....	....	CaO. Al_2O_3
"	91.87	7.36	.65	.02	.01	.09	.02	.....	.....	.....	....	......

Indet.	Total.	Sp. Gr.	Analyst.	Reference.
.....	99.45	....	J. L. Smith.........	1860, A. J. S (2), XXX, 240
.....	99.32	7.89	J. L. Smith.........	1861, A. J. S. (2), XXXI, 265-266
.....	100.23	....	O. Bürger..........	1905, Meteoritenkunde, III, 358
.....	100.25	7.904	L. Fletcher.........	1889, Min. Mag. VIII, 258
.....	100.13	7.83	J. C. H. Mingaye ...	1893, Jour. Roy. Soc. N. S. W. XXVII, 82-83
.....	99.57	7.48	M. Van der Boom Mesch ...	1866, Archives Neerl. I, 468
.....	99.73	7.83	E. H. von Baumhauer	" " " "
.....	100.004	....	Vlaanderen	1867, Nat. Tij. Ned. Ind., XXIX, 268-270
.....	100.55	....	O. Sjöström	1897, Meteoreisen-Studien, A. N. H. XII, 42-62
.....	99.61	....	De Jong	1904, Javabode, July 12, 5
.....	100.00	7.69	C. U. Shepard	1854, A. J. S. (2), XVII, 331-332
.....	99.56	....	Knauer & Bürger...	1905, Meteoritenkunde, III, 345
.....	99.25	7.72	J. L. Smith.........	1866, A. J. S. (2), XLII, 218-219
.....	99.50	7.692	C. T. Jackson	1867, A. J. S. (2), XLIII, 281
.....	100.07	....	J. E. Whitfield......	1901, Proc. Roch. Acad. Sci. IV, 65-66
.....	100.00	....	F. A. Genth........	1877, A. J. S. (3), XIII, 214
.....	99.46	7.78	J. L. Smith.........	" " "
.....	100.43	....	O. Bürger..........	1905, Meteoritenkunde, III, 379
.....	99.77	7.863	L. Fletcher.........	1889, Min. Mag. VIII, 259
.....	100.00	7.827	L. R. DeLoza.......	1876, Proc. Phila. Acad. Sci., 126
.....	100.02	....	O. Bürger..........	1905, Meteoritenkunde, III, 320

b. RODEO GROUP

The nickel-cobalt content is somewhat higher than in the Pram-

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Alt-Biela	85.34	12.89	.41	....	....	.39	.06	.02	.....	.....	.86	......
Bear Creek	83.89	14.06	.83	tr.	....	.21	......	.....	.....	.....	....	......
Quesa	87.97	10.75	1.07	.04	....	.19	tr.	.....	.....	.....	....	......
Rodeo	86.95	11.27	1.20	.01	.03	.25	.01	.....	.....	.....	.07	......
"	89.84	8.79	.28	.07	....	.80	.02	.09	.....	.....	....	......

5. FINEST OCTAHEDRITES.

Width of lamellæ not exceeding 0.2 mm. The nickel-cobalt content lies, as a rule, between 10 and 15 per cent. Plessite strongly developed. Cohen divides the class into two groups, the Salt River group and the Tazewell group.

SALT

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscel
Bacubirito	88.94	6.98	.21	....	....	.15	.005	.....	tr.	.....	....	......
"	89.54	9.40	.98	.02	.02	.12	.02	.01	.....	.02	....	Chrom
Ballinoo	89.34	9.87	.60	.06	....	.48	.03	.02	.....	.....	....	......
"	89.91	8.85	.74	tr.	....	.50	tr.	tr.	tr.	.....	....	......
Butler 2/2	89.12	10.02	.26	.01	....	.12	......	.....	.....	.....	....	......
Salt River	90.74	9.36	.....	....	....	......	tr.	.....	.....	.....	.26	Mg. N
" 2/2	90.89	8.70	.85	.04	....	.34	tr.	.02	.....	.....	....	......

banan group, so that the group is a transition to the finest octahedrites.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	99.97	7.525	M. Neff & A. Stocky	1899, Prog.d.Böhm Gym.in Mahr-Ostrow
....	98.99	....	J. L. Smith	1867, A. J. S. (2), XLIII, 280
....	100.02	....	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H. XV, 379
....	99.79	....	O. Bürger..........	1905, Meteoritenkunde, III, 299
....	99.89	....	H. W. Nichols......	1905, Field Col. Mus. Geol. Ser. III, 4

a. SALT RIVER GROUP.

The content of nickel-cobalt is lower than in the Tazewell group, not exceeding 10½ per cent. Plessite predominates as compared with the Tazewell group. Schreibersite is common in numerous small, elongated individuals.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
.....	96.285	7.69	J. E. Whitfield	1902, Proc. Roch. Acad. Sci. IV, 74
.....	100.14	7.59	Cohen & Hildebrand	1903, Mitt. N. Ver. f. Neu Vorp. u. Rügen, XXXV, 13
.....	100.40	7.8432	O. Sjöström........	1898, Ber. Berlin Akad., 19–22
.....	100.00	7.8	Mariner & Hoskins.	1898, A. J. S. (4), V, 137
.....	99.53	7.72	J. L. Smith.........	1877, A. J. S. (3), XIII, 213
.....	100.36	....	W. H. Brewer......	1851, Proc. A. A. A. Sci. IV, 36–38
.....	100.84	7.6648	J. Fahrenhorst	1900, Meteoreisen-Studien, X, A. N. H. XV, 76

b. TAZEWELL GROUP.

This group includes the octahedrites having the highest percent-

TAZE

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscella
Carlton..........	86.54	12.77	.63	.02	....	.16	.03	.11	....	....	....	......
Laurens County...	85.33	13.34	.87	....	....	.16	tr.	tr.	....	....	....	......
Mart............	89.68	9.20	.33	.04	tr.	.16	.02	....	....	....	....	......
Mungindi........	90.31	8.23	1.36	....	....	.09	tr.	.01	tr.	....	....	......
"	87.96	10.99	.88	.08	.03	.17	.21	....	....	....	....	......
Narraburra Creek.....¼	88.60	9.74	.47	.01	....	.43	tr.	....	....	....	.72	Resinous
Tazewell........⅔	82.70	14.82	.46	.07	....	.18	.08	....	....	.02	....	Mg.O .24,

c. COWRA AND VICTORIA WEST.

Cowra and Victoria West resemble the Salt River group in their predominance of plessite. Their place among the octahedrites is not

COWRA

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si,	Cl.	In-sol.	Miscell
Cowra..........⅔	85.26	13.23	1.02	.02	....	.22	.01	.03	.01	....	....	Sn.and
Victoria West.....	88.83	10.14	0.53	tr.	....	.28	......	....	....	....	....	......

B. HAMMOND OCTAHEDRITES.

These meteorites appear in section to be granular aggregates in which black particles and taenite-like lamellæ extend in directions parallel to octahedral planes. They thus have resemblances to the octahedrites and form a transition to the ataxites. The structure by which they are characterized may be either original or secondary. If original, the structure has been produced by the separation of the nickel-rich alloy and black particles to form a web, the lines of which

HAM

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Cacaria..........	87.38	12.06	.65	.02	.01	.22	.05	....	....	....	.09	SiO_2 ..
"	92.00	7.70	.54	.03	.01	.24	.06	....	....	....	....	......
Hammond........	89.78	7.65	1.32	tr.	....	.51	......	tr.	....	....	....	Sn. tr. S
"	91.62	7.34	1.01	.04	.01	.52	.01	.06	....	.01	....	......
Reed City........	89.39	8.18	....	....	....	....	......	....	....	....	....	......

age of nickel-cobalt.. It reaches 15 per cent. and more. Taenite is strongly developed.

'P.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	100.26	7.95	L. G. Eakins.......	1890, A. J. S. (3), XL, 223–224
......	99.70	....	J. B. Mackintosh....	1886, A. J. S. (3), XXXI, 463–465
......	99.43	....	H. N. Stokes	1900, Proc. Wash. Acad. Sci. II, 53
......	100.00	7.4	Mariner & Hoskins.	1898, A. J. S. (4), V, 139
......	100.32	....	R. Knauer	1905, Meteoritenkunde, III, 269
......	99.98	7.57	A. Liversidge.......	1903, Proc. Roy. Soc. N. S. W. XXXVII, 240
......	99.22	7.89	J. L. Smith.........	1855, A. J. S. (2), XIX, 153

certain, however, and it seems desirable therefore to group them separately. Their percentage of nickel-cobalt resembles that of the finest octahedrites, 11 to 15 per cent.

ORIA WEST.

Undet.	Total.	Sp. Gr,	Analyst.	Reference.
......	99.80	7.805	J. C. H. Mingaye ...	1904, Rec. Geol. Sur. N. S. W., VII, 31
......	99.78	7.692	J. L. Smith.........	1873, A. J. S. (3), V. 108

accord with octahedral planes. In the meshes of this web the nickel-poor remainder is deposited as a homogeneous, granular aggregate. If the structure is secondary, it may be explained by supposing that a normal octahedrite was somewhat softened by heat, so as to destroy the lamellar structure in part, after which solidification took place. If this latter be the correct explanation, the softening was carried farther in Hammond than in Cacaria and Reed City.

HEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
......	100.64	7.7070	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H., XV, 362–363
......	100.58	....	"	Same
......	99.82	7.601–7.703	Fisher & Allmendinger	1887, A. J. S. (3), XXXIV, 383
......	100.62	7.288–7.506	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H., XV, 356
......	97.57	7.6	J. E. Whitfield	1903, Jour. Geol., XI, 233

C. BRECCIATED OCTAHEDRITES.

In these, as in the brecciated hexahedrites, the mass appears to be

BRECC

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Barranca Blanca..	91.50	8.01	.65	tr.	....	.15	.13	.....	.....	.....	.03	....
N'Goureyma......	89.28	9.26	.60	.04	.11	.05	.77	.04	.....	.....	.24	Ce.... Chromi
"	91.99	7.15	tr.	....	....	......	......	.....	.....	.....	....	Fe.S.. Graphite,
Santa Rosa 3/8	91.46	7.72	.....	....	....	......	......	.....	.....	.....	.28	....
"	92.30	6.52	.78	.02	tr.	.36	.04	.18	.....	.....	....	....
Tula	93.50	2.50	.....	....	....	......	......	.....	.....	.....	....	Sn.
"	96.40	2.63	.....	....	....	......	......	.....	.....	.....	....	Schreibers Sn. .07
Zacatecas.........	89.84	5.96	.62	tr.	....	......	.13	.....	.....	.....	3.08	Mg. tr.
"	90.91	5.65	.42	....	....	.23	.07	.....	.50	.....	2.17	....
"	91.30	5.82	.41	tr.	....	.25	......	.....	.....	.....	2.19	Mg., tr.
"	92.09	5.98	.91	....	.74	1.02	......	.....	.....	.....	.04	....

made up of numerous individuals, the direction of whose lamellæ differs in the individual grains.

HEDRITES.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
.....	100.47	7.823	L. Fletcher	1889, Min. Mag., VIII, 263
.....	100.49	7.6722	E. Cohen	1901, Mitt. Nat. Ver. f. Neu. Vorp. u. Rügen, XXXIII, 14
.....	99.36	7.31	S. Meunier.........	1901, Compt. Rendus, CXXXII, 444
.....	99.46	7.30–7.60	Rivero and Boussingault ...	1824, Ann. Phys. Chem., XXV, 438–443
.....	100.20	7.6896	O. Sjöström........	1899, Meteoreisen-Studien, VIII, A. N. H., XIV, 138
.....	96.90	7.332	W. Haidinger	1861, A. J. S. (2), XXXII, 144
.....	100.00	....	J. Auerbach	1863, Neues Jahrb., 362
.....	99.63	7.20	H. Müller..........	1860, Jour. f. prakt. Chemie, LXXIX, 25
.....	99.95	7.625	"	" " " "
.....	99.97	7.50	"	" " " "
.....	100.78	....	E. Cohen	1897, Meteoreisen-Studien, V, A. N. H., XII, 51

III. ATAXITES.

These iron meteorites are characterized by a fine granular to compact structure throughout. They show no evidence of the cubic cleavage and Neumann lines which characterize the hexahedrites, nor of the lamellar structure, octahedrally arranged, of the octahedrites. The individual grains are in some cases visible to the naked eye, but for the most part are of microscopic or sub-microscopic dimensions. In some occur peculiar streaks which seem to have crystallographic arrangement, but their exact relations have not been determined. These form a special group, which, while not ataxites in the strictest sense of the term, may be included among them for present purposes. The ataxites show the greatest variation among all iron meteorites in their nickel-cobalt content. This varies from 6 to 16 per cent, and in the doubtful Oktibbeha to 63 per cent. Two general

SI

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Campo del Cielo .. (Wöhler's Iron.)	92.33	7.38		....	....	......	......	.....	.....	.....	....	P. Fe. Sn ....
....	89 22	9.51		....	....	.20	......	tr.	.....	.....	....	Schreibers C. etc.
....	94.25	5.11	.57	.03	.03	.18	.05	.....	.....	tr.	....	....
Cincinnati	94.47	5.43	.68	.01	....	.05	.05	.....	.....	.....	....	....
Locust Grove	94.30	5.57	.64	tr.	....	.18	.05	.02	.....	.01	....	....
San Francisco del Mezquital	93.38	5.89	.39	....	....	.23	......	.....	.....	.....	....	....
" "	93.36	5.46	.87	.03	....	.16	.15	.....	.....	.....	....	....
Siratik (Senegal)..	94.07	5.21	.77	.01	....	.26	.04	.01	.....	.....	....	....

subdivisions may be made of the ataxites, according as they are nickel-poor or nickel-rich. Transitions occur between these, but a general grouping is practicable. Accessory constituents are not usually abundant in the ataxites, and when occurring are of small dimensions as a rule.

A. NICKEL-POOR ATAXITES.

The nickel-cobalt content lies between 6 and 7 per cent, the composition thus corresponding to that of kamacite. The structure is, as a rule, plainly granular, seldom compact, the size of the grains reaching 0.75 mm.

1. SIRATIK GROUP.

An etched surface appears rough through the presence of irregularly arranged depressions, due perhaps to the solution of some accessory constituent, such as troilite or schreibersite. The smaller the depressions the more plainly the boundaries of the grains appear. The latter range from 0.33 to 0.75 mm. in dimension.

JP

Unde.	Total.	Sp. Gr.	Analyst.	Reference.
......	100.16	7.547	N. S. Manross......	1853, A. J. S. (2), XV, 22
......	99.23	7.85	C. Martius	Ann. Chem. u. Pharm., CXV, 92
......	100.28	7.7679	O. Sjöström	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 124
......	100.69	7.6895	"	1898, Ber. Berlin Akad., 428-430
......	100.77	7.7083	"	1897, Ber. Berlin Akad., 76-81
......	99.89	7.83	A. A. Damour......	1868, Comptes Rendus, LXVI, 573-574
......	100.03	7.7687	J. Fahrenhorst	1900, Meteoreisen-Studien, XI, A. N. H., XV, 365
......	100.37	7.7752	O. Sjöström	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 131

2. NEDAGOLLA GROUP.

Both granular and compact irons occur in this group. They lack the rough appearance of the Siratik group on etched surfaces. The

NEDA(

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Chesterville.......	95.00	5.00	....	....	tr.	tr.	.....	....	....	....	....	......
"	93.15	5.82	.73	....	....	.34	.....	....	....	....	....	......
"	93.80	5.50	.75	.02	tr.	.34	.03	.02	....	....	....	......
Forsyth County...	94.90	4.18	.33	....	....	tr.	.22	....	....	....	....	......
(Compact portion.).	94.03	5.55	.53	.02	....	.23	.03	.02	....	tr.	....	......
(Granular portion).	94.18	5.56	.60	.02	....	.19	.05	.04	....	.17	....	......
Nedagolla	92.61	6.20	.49	tr.	....	.02	.05	....	.25	....	....	......
Nenntmansdorf ...	94.50	5.31	....	....	....	.....	.....	....	....	....	....	......
" ...	93.04	6.16	....	....	....	.22	.....	....	....	....	....	......
" ...	94.33	5.48	.71	....	....	.29	.....	....	....	....	....	......
Primitiva	94.72	4.72	.71	tr.	....	.18	.02	.03	....	....	....	......
Rasgata	90.76	7.87	....	....	....	.....	.....	....	....	....	....	......
"	92.35	6.71	.25	tr.	....	.35	tr.	....	....	....	....	P. Fe. Silicate Sn. ....
"	92.81	6.70	.64	.01	tr.	.28	.08	.19	....	....	....	......

3. RAFRUTI GROUP.

The members of this group resemble the granular members of the

RA

Name.	Fe.	Ni.	Co.	Cu.	Cr	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Illinois Gulch......	92.51	6.70	.16	....	....	.62	.....	.01	tr.	....	....	......
" ....⅔	86.77	12.67	.81	.02	.01	.08	tr.	....	....	....	....	......
Rafrüti	89.87	9.54	.61	.03	.01	.06	.11	.18	....	....	....	......

size of the grains in the granular members is generally less than 0.5 mm., rarely 0.75 mm. No granular structure is visible, even on strong magnification, in the compact members. Chesterville and Rasgata are rich in rhabdite.

P.

Undet.	Total.	Sp. Gr.	Analyst.	Reference
.....	100.00	7.82	C. U. Shepard	1849, A. J. S. (2), VII, 449
.....	100.04	....	O. Sjöström	1897, Meteoreisen-Studien, V, A. N. H., XII, 47
.....	100.46	7.8209	"	1898, Meteoreisen-Studien, VIII, A. N. H., XIV, 150
.....	99.63	....	E. A. de Schweinitz	1896, A. J. S. (4), I, 208–209
.....	100.41	7.4954	O. Sjöström........	1897, Ber. Berlin Akad., 386–396
.....	100.81	7.3357	"	" " "
.....	99.62	7.8613	"	1897, Meteoreisen-Studien, VI, A. N. H., XII, 121
.....	99.81	....	G. E. Lichtenberger	1873, Sitz. Isis. p. 4, Dresden
.....	99.42	6.21	E. Geinitz	1876, Neues Jahrb., 609
.....	100.81	7.8241	E. Cohen...........	1897, Meteoreisen-Studien, V, A. N. H., XII, 42
.....	100.38	....	O. Sjöström........	1897, Meteoreisen-Studien, VI, A. N. H., XII, 123
.....	98.63	7.6	Rivero and Boussingault....	1824, Ann. Chem. Phys., XXV, 442–443
.....	100.11	7.33–7.77	F. Wöhler..........	1852, Ann. Chem. Pharm., LXXXII, 243–248
.....	100.71	7.654	O. Sjöström	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 143

Nedagolla group, but have an essentially higher nickel-cobalt content, and thus form a transition to the nickel-rich ataxites.

P.

Undet.	Total.	Sp. Gr.	Analyst.	Reference.
.....	100.00	7.7	Mariner and Hoskins	1900, A. J. S. (4), IX, 201–202
.....	100.36	7.8329	J. Fahrenhorst......	1900, Meteoreisen-Studien, XI, A. N. H., XV, 353
.....	100.41	7.596	Cohen and Hildebrand.....	1902, Mitt. Nat. Ver. f. Neu. Vorp. u. Rügen, XXXIV, 87

B. NICKEL-RICH ATAXITES.

These ataxites are fine-grained to compact, and acquire, as a rule, on weak etching, a characteristic varnish-like luster. Stronger etching produces a dull surface, having a peculiar velvety sheen. The

SMITI

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Babb's Mill (Troost Iron)	85.30	14.70	....	....	....	......	......	.....	.....	.....	....	Al. Mg
"	87.16	9.76	....	....	....	......	......	.....	.....	.....	....	......
"	80.59	17.10	2.04	....	....	......	......	.....	tr.	.....	.12	Mn. .. P. Fe.
"	81.54	17.74	1.26	....	....	.11	......	.....	.....	.....	....	P. Fe.
"	81.45	17.30	1.67	.03	.03	.12	.01	.07	.....	.....	....	......
(Blake Iron)	91.42	7.95	....	....	....	......	......	.....	.....	.....	....	......
"	86.30	12.58	1.66	....	....	......	......	.....	.....	.....	....	......
"	88.23	11.01	.72	....	.02	tr.	tr.	.03	.....	.01	....	......
"	88.41	11.09	.66	....	.02	tr.	tr.	.03	.....	.02	....	......
Botetourt	85.88	18.23		....	....	......	......	.....	.....	.....	....	......
Deep Springs	87.01	11.69	.79	....	....	.04	......	.....	.53	.39	....	......
"	85.99	13.44	.70	.03	.03	.06	......	.02	.....	.02	....	......
Dehesa	86.20	14.20	....	....	....	......	......	.....	.....	.....	....	......
Linville	84.56	14.95	.33	....	....	tr.	.12	tr.	.....	.....	....	......
"	83.13	16.32	.76	.02	....	.23	.02	.11	.....	.....	....	......
Morradal	79.67	18.77	1.18	.06	.06	.18	.27	.....	.....	.....	....	......
Smithland	82.83	16.42	.94	....	.06	.09	.17	.....	.....	.....	....	......
Weaver	80.78	17.92	.84	....	....	.12	.15	.....	.....	.....	.15	......

nickel-cobalt content lies, for the most part, between 14 and 20 per cent, though it drops to 12 and rises to 26½ per cent.

1. SMITHLAND GROUP.

The nickel-cobalt content does not exceed 20 per cent.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	100.00	7.548	C. U. Shepard	1847, A. J. S. (2) IV, 76–77
....	96.92	....	G. Troost	1845, A. J. S. (1), XLIX, 342–344*
....	99.85	7.839	W. S. Clark........	1852, Metallic Meteorites, 65–66
....	100.70	7.7948	E. Cohen	1892, Meteoreisen-Studien, II, A. N. H., VII, 147, 148
....	100.68	....	J. Fahrenhorst	1900, Meteoreisen-Studien, X, A. N. H., XV, 93
....	99.37	7.858	W. P. Blake........	1886, A. J. S. (3), XXXI, 44
....	100.54	....	Cohen and Weinschenk.....	1891, Meteoreisen-Studien, I, A. N. H., VI. 142–143
....	100.02	....	J. Fahrenhorst	1900, Meteoreison-Studien, X, A. N. H., XV, 93
....	100.23	....	"	Same
....	104.11	8.186	O. Sjöström........	1898, Meteoreisen-Studien, VII, A. N. H., XIII, 49
....	100.45	....	F. P. Venable......	1890, A. J. S. (3), XL, 162
....	100.29	7.4538	J. Fahrenhorst	1900, Meteoreisen-Studien, XI, A. N. H., XV, 355
....	100.40	7.8892	J. Domeyko........	1879, Mineralojia, Santiago
....	99.96	....	J. E. Whitfield	1888, A. J. S. (3), XXXVI, 276
....	100.59	7.4727	O. Sjöström........	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 147
....	100.19	7.8543	"	1898, Videnskabsselskabets Skrifter (1), VII, 11
....	100.51	7.7115	"	1898, Meteoreisen-Studien, VII, A. N. H., XIII, 47
....	99.96	7.12	Lindner............	1904, Sitzb. K. Preus. Akad. der Wiss. XXXII

*Recalculated by Cohen, Meteoritenkunde, Heft III, p. 104.

2. CRISTOBAL GROUP.

The nickel-cobalt content exceeds 20 per cent.

CRIS

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Limestone Creek..	65.18	27.71	.....	....	....	......	......	.....	.....	.....	....	....
" " ..	66.56	24.71	.....	....	....	......	4.0	.....	.....	1.48	....	Cr.&M
" " ..	83.57	12.67	.....	....	....	......	......	.....	.....	.91	....	FeS_2 ..
" " ..	65.03	29.99	1.48	....	....	.19	......	.....	.....	.....	....	....
San Cristobal	73.72	25.60	1.0	....	....	.18	......	.....	.....	.....	....	....

3. OKTIBBEHA.

The meteoric origin of Oktibbeha is doubtful, on account of its

OKTI

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Oktibbeha	37.69	59.69	.40	.90	....	.10	......	.....	.12	.....	....	Al..... Ca....
"	37.24	62.01	.72	.28	....	.15	......	.....	.....	.....	....	....

C. ATAXITES WITH ACCESSORY FORSTERITE.

The accessory occurrence of forsterite is characteristic. It forms about five per cent of the mass, occurring in small spheroidal grains or elongated aggregates of grains, and is accompanied by some plagioclase. In nickel-cobalt content the metallic portion of the meteorite

ATAXITES

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	SiO_2	Cl.	In-sol.	Miscell
Tucson	85.54	8.55	.61	.03	....	.12	......	.....	3.02	.....	....	MgO 2.04 Al_2O
"	83.55	9.20	.39	.01	.17	.13	......	.....	3.01	.....	....	Labradorit CaO .51
(Carleton Iron)......	81.56	9.17	.44	.08	....	.49	......	.....	3.63	.....	....	FeO .12 MgO 2.43
"	84.56	8.89	1.36	.03	.02	.16	tr.	.04	1.72	.04	....	MgO .. Chrys. res
(Ainsa Iron)	84.60	9.24	.95	.02	.02	.17	.01	.04	1.76	.04	....	MgO .. Chrys.res.

* K_2O, .10; Na_2O, .17.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	92.89	5.75	C. T. Jackson.......	1838, A. J. S. (1), XXXIV, 335
....	99.99	5.75–6.40–6.50	"	" " " "
....	100.00	6.82	A. A. Hayes........	1845, A. J. S. (1), XLVIII, 153
....	96.89	....	R. Knauer.........	1905, Meteoiitenkunde, III, 131
....	100.50	7.8593	"	1899, Ber. Berlin Akad., 607–608

anomalous composition. It may however for the present be included among meteorites.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	99.19	6.854	W. J. Taylor.......	1857, A. J. S. (2), XXIV, 294
....	100.40	....	E. Cohen..........	1892, Meteoreisen-Studien, II, A. N. H., VII, 146

lies between the nickel-rich and nickel-poor ataxites. On etching, irregularly shaped areas appear, 0.2–2 cm. in area, which under the microscope have a spotted look and are generally bordered, as are most of the silicate grains, by narrow, zigzag bands the nature of which cannot be further determined.

sory Forsterite.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	100.12	6.52–7.13	J. L. Smith.........	1855, A. J. S. (2), XIX, 161–162
....	100.55	....	F. A. Genth........	1855, A. J. S. (2), XX, 119–120
....	99.69	7.29	G. J. Brush.........	1863, A. J. S. (2), XXXVI, 153
....	101.09	7.2248	J. Fahrenhorst......	1900, Cohen-Festschrift, Greifswald, 39
....	100.75	....	"	" " "

D. ATAXITES WITH CUBIC STREAKS.

Upon etching appear bands or spots which seem to be oriented according to cubic faces, and which according to the position of the plates toward impinging light appear brighter or darker than the principal mass of the nickel-iron without a structural distinction being discernible. In one position the reflection of the whole face is plainly uniform. On weak etching appears, as a rule, a characteristic luster.

ATAXITES

Name.	Fe.	Ni.	Co.	Cu.	Cr.	P.	S.	C.	Si.	Cl.	In-sol.	Miscell
Cape of Good Hope	78.90	15.28	1.0	....	....	......	......	.....	.....	.....	....	Ca. 1.41, Mg. .15, Graphite
"	85.61	12.27	.89	....	....	......	......	.....	.....	.....	....	......
"	81.20	15.09	2.56	tr.	....	.09	tr.	.....	.....	.....	.95	Sn....
"	81.30	15.23	2.01	tr.	....	.08	tr.	.....	.....	.....	....	P. Fe. Sn.....
"	82.77	14.32	2.52	tr.	....	.26	......	.....	.....	.....	....	......
"	82.87	15.67	.95	.03	.04	.09	......	.03	.....	.01	...	......
Iquique...........	83.83	15.86	.19	....	....	.05	......	.....	.....	.....	.07	......
"	83.49	15.41	.94	.02	tr.	.07	.02	.03	.....	.....	....	.....
Kokomo..........	87.02	12.29	.65	tr.	....	.02	......	.....	.....	.....	....	......
"	83.24	15.76	1.07	.01	....	.08	tr.	.....	.....	.....	....	......
Shingle Springs...	88.02	8.88	.....	....	....	......	......	.....	.....	.....	3.5	......
" ...	80.74	15.73	.....	....	....	......	......	.....	.....	.....	....	Sn..... P. etc.
" ...	81.48	17.17	.60	....	.02	.31	.01	.07	.03	.....	....	Ca. .16, Mg. .01
" ...	82.21	16.69	.65	.02	.02	.34	.05	.03	.....	.....	....	......
Ternera	83.02	16.22	1.63	tr.	....	......	......	.....	.....	.....	....	......
"	82.17	16.22	1.42	....	....	.11	.13	.....	.....	.....	....	......

On strong etching the surface becomes dull with a peculiar velvet sheen. No cleavage has been observed. On the other hand, a certain orientation of similarly situated particles is indicated by the appearance in reflected light. The structure of the nickel-iron is compact; the content in nickel plus cobalt 16–17 per cent. Except for the etch bands, the members of this group are similar in chemical composition and luster to the etched faces of members of the Morradal group.

STREAKS.

ndet.	Total.	Sp. Gr.	Analyst.	Reference.
....	100.00	7.544	V. Holger..........	1830, Zeit f. Phys. u. Math., VIII, 279–284
....	98.77	7.66	A. Wehrle.........	1835, Zeit. f. Phys. u. Math. (2), III, 222–229
....	99.89	6.63–7.94	E. Uricoechea......	1854, Ann. Chem. u. Pharm., XCI, 252
....	99.50	7.60	M. Böcking	1855, Ann. Chem. u. Pharm., XCVI, 243–246
....	99.87	7.71	Baumhauer and Seelheim ...	1867, Arch. Neerland, II, 376–384
....	99.69	7.8543	J. Fahrenhorst	1900, Meteoreisen-Studien, X, A. N. H., XV, 87
....	100.00	7.925	C. Rammelsberg....	1873, Fest. Ges. Natur. Freunde, Berlin, 37
....	99.98	7.8334	O. Sjöström........	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 153
....	99.98	7.821	J. L. Smith.........	1874, A. J. S. (3), VII, 392
....	100.16	7.8606	O. Sjöström........	1898, Meteoreisen-Studien, VIII, A. N. H., XIII, 118–158
...	100.00	7.80	C. U. Shepard......	1872, A. J. S. (3), III, 438
....	100.00	7.9053	C. T. Jackson.......	1872, A. J. S. (3), IV, 495
....	99.98	7.875–8.024	F. A. Cairns........	1873, A. J. S. (3), V, 21
....	100.01	7.8943	O. Sjöström........	1898, Meteoreisen-Studien, IX, A. N. H., XIII, 479–480
....	100.87	7.694	E. Weinschenk.....	1892, A. J. S. (3), XLIII, 425
....	100.05	....	Lindner............	1904, Ber. Berlin Akad., 151

ANALYSES OF OCCLUDED GASES.

The occluded gases of nine iron meteorites have been determined. These are here shown.

Name.	Vols.	H.	CO_2	CO.	N.	CH_4	Analyst.	Reference.
Charlotte	2.20	71.40	13.30	15.30	.....	.....	A. W. Wright..	1876, A. J. S. (3), XI, 257
Cranbourne	3.59	45.79	0.12	31.88	17.66	4.55	W. Flight	1882, Ph. Tr. Roy. Soc. London, 893 896
Lenarto	2.85	85.68	.....	4.46	9.86	.....	Th. Graham ...	1866, Proc. Roy. Soc., London, XV, 502-503
Magura	47.13	18.19	12.56	67.71	1.54	.....	A. W. Wright..	1876, *op. cit.*
Red River.....	1.29	76.79	8.59	14.62	.....	....	A. W. Wright..	1876, *op. cit.*
Rowton	6.38	77.78	5.15	7.34	9.72	.....	W. Flight	1882, *op. cit.*
Shingle Springs	0.97	68.81	13.64	12.47	5.08	.....	A. W. Wright..	1876, *op. cit.*
Staunton	3.17	35.83	9.75	38.33	16.09	.....	J. W. Mallet ...	1871, Proc. Roy. Soc. London XX, 365-370
Tazewell	3.17	42.66	14.40	41.23	1.71	.....	A. W. Wright..	1876, *op. cit.*

DISCUSSION OF ANALYSES.

The most striking feature brought out by the analyses is the relation shown between chemical composition and structure. This seems to be definite and general. All the meteorites of a hexahedral structure have a nearly uniform composition, while among the octahedral meteorites, fineness of structure increases with increase of nickel. This conclusion can best be shown by obtaining the averages from the analyses of the different groups, omitting all obviously faulty analyses. The results thus obtained are as follows:

Class.	No. of Analyses.	Width of Lamellæ in Millimeters.	Per Cent Fe.
Hexahedrites............	29	------	94.12
Coarsest Octahedrites....	12	+ 2.5	93.18
Coarse "	22	2.0-1.5	92.28
Medium "	88	1.0-0.5	90.64
Fine "	41	0.4-0.2	90.18
Finest "	13	0.2- —	88.51

It is worthy of note that these averages are not means between wide limits, but are derived from nearly uniform values. Practically

all of the members of the classes conform in composition to the average. Were all the groups equally well known, it is probable, too, that the gradation of percentage of Fe would be even more uniform than here shown. The medium octahedrites, for example, while numerous, have been as a whole imperfectly analyzed. Moreover, some of the meteorites classed as medium octahedrites, which are characterized by low percentage of iron, such as Algoma and Glorieta Mountain, have width of lamellæ such as to place them near if not in the fine octahedrites.

The apparent conclusion from the above results is, that the content of nickel influences the structure. It may also account for the change from a hexahedral to an octahedral structure, since the irons with a hexahedral structure have the lowest per cent of nickel. So constant and definite does this relation hold, that given a certain structure the per cent of nickel can probably be stated more accurately by this principle than it has been determined in some analyses. The per cent of nickel in iron meteorites as a whole, as shown by the reliable analyses, lies between five and twenty-six per cent. An exception to the latter figure may be found in the quoted analyses of Limestone Creek, but of this unfortunately no complete analysis exists. The somewhat doubtful Oktibbeha is also an exception, its percentage of nickel reaching sixty per cent. Cobalt in the iron meteorites rarely exceeds one per cent. No constant relation in amount appears to exist between it and nickel, although perhaps as a rule it is higher with higher nickel. Copper is doubtless, as claimed by Smith, a constant ingredient of iron meteorites. It is usually only a few hundredths of one per cent in amount, but may reach a few tenths. Chromium is shown by the analyses to be a frequent though not constant ingredient in minute quantities. In many cases it is probably present as daubreelite, but also, as suggested by Cohen, it may occur as an element alloyed with nickel-iron. Reports of the presence of manganese and tin are so frequent as to leave little doubt that they occur in many iron meteorites, perhaps alloyed as metals. The presence of platinum and iridium has been proved by Davison in Coahuila and Franceville, and doubtless could be found to exist in more meteorites if proper search were made. Gold was reported in Boogaldi by Liversidge, but in so small a quantity as to make its determination as yet not quite positive. The presence of occluded gases has been determined in but few cases. The constant presence of phosphorus in iron meteorites is a feature shown by the analyses. Apparently no iron meteorite is lacking in this element altogether, and in amount and constancy it con-

siderably exceeds sulphur. It probably occurs combined with nickel-iron as phosphide. Sulphur, though evident by its presence in many meteorites as troilite, does not appear in large amounts in the analyses, and does not seem to be so important or constant an ingredient as phosphorus. Carbon is probably more frequent in occurrence than analyses usually show, since of twenty-eight iron meteorites investigated by Cohen for carbon all but one showed appreciable percentages, ranging from .19 per cent to .012 per cent.* The silicon reported in the analyses is doubtless in some cases to be referred to silicate grains, but in other cases may be free or combined with the iron as a silicide. The analyses make plain the incompleteness of much of the work which has been done hitherto. There can be little doubt that complete analyses of iron meteorites should always show iron, nickel, cobalt, copper, and phosphorus, and in most cases sulphur, carbon, and silicon. When considerable differences occur in the analyses of the same meteorite, as, for instance, 2 per cent of nickel reported in Burlington by Rockwell and nearly 9 per cent by Shepard, the difference is probably not to be regarded as due to the meteorite, but to the analyses. In a substance made up of different alloys and accessory minerals as are the iron meteorites, especially the octahedrites, there can be no question that portions from different parts of the meteorite would of necessity show unlike composition. How wide these variations might legitimately be it is difficult to say, but some causes of error may be suggested. One of these is imperfect sampling. The proper method to secure material for mass analyses of an iron meteorite, especially if of octahedral structure, is to use dust obtained by boring. A mixture of the constituents of the meteorite is thus obtained which insures a better representation of its composition than is possible when only a fragment broken from some part of the surface is used. Such a fragment may contain an excess of taenite, or be largely composed of some accessory mineral so as to be far from representing the true constitution of the meteorite. Yet the larger number of analyses of iron meteorites have probably been made with fragments of this character, and the wonder is, not that they show so much variation, but that they do not show more. Meteorites also doubtless vary in their homogeneity, as shown especially by Canyon Diablo, in one portion of which Moissan found 2.89 per cent of nickel, and in another, only one centimeter distant, 5.06 per cent. In another piece of Canyon Diablo two analyses made by the same analyst of material obtained at distances of one centimeter showed 1.17 per cent and 7.11 per cent of

* Meteoritenkunde, Heft II., p. 243.

nickel.* While few meteorites probably vary to this extent, such determinations show the need of as thorough sampling as possible if a mass analysis is to be made. Occasionally a marked variation in the analyses of a meteorite seems explicable only on the assumption that the material analyzed did not belong to that meteorite. Such, for instance, seems the most reasonable explanation for the percentage of nickel, 12.67 per cent, reported by Hayes for Limestone Creek, as compared with the percentages, 25–30 per cent, obtained by other analysts. Errors of this sort are obviously difficult to detect, and can only be surmised in extreme cases. Another and more serious cause of discrepancies in analyses is the imperfect separation by the analyst of nickel and cobalt from the iron. The methods for this separation are not altogether satisfactory, even at the present day, and in earlier years they were much less so. Consequently the results of the earlier analysts were for the most part too low in these ingredients. The determinations of specific gravity shown in the tables appear in some cases to have been equally open to sources of error with the analyses. It can easily be calculated that the specific gravity of an iron meteorite is likely to be between 7.6 and 7.9, since the specific gravity of pure iron, 7.85, will be increased by that of nickel, 8.8, according to the proportion of the latter. It will be decreased by accessory minerals, such as troilite, which has a specific gravity of 4.7, schreibersite, 6.5, graphite, 2.2, and oxidized ingredients. Any porosity of the meteorite will also lessen its specific gravity. It is obvious, therefore, that determinations of specific gravity made on small fragments can hardly represent that of the mass as a whole, since they may contain a disproportionate quantity of accessory ingredients or may be more oxidized than the main mass. It is hardly credible that porosity or accessory ingredients of a meteorite would in any case reduce its specific gravity below 7. Determinations below this figure, therefore, probably indicate that oxidized material was used. From the showing in the tables that large numbers of meteorites have practically similar composition, it is evident that similarity of composition cannot be used, as has often been done hitherto, to prove identity of origin of meteorites found at different places. This method at one time obtained considerable vogue. Dissimilarity of composition, on the other hand, as a rule indicates separate falls. The only marked exception to this rule seems to be furnished by the two masses of Babb's Mill, one of which shows about 11 per cent, the other about 17 per cent, of nickel. The only alternative supposition possible here

* C. R., 1893, cxvi., 290.

is that two ataxites fell at different times at one locality. In view of the small number of ataxites known, this seems less likely than to suppose that two masses of the same fall differed in composition. No other case of such marked difference is known. Differences of structure seem as a rule to be a better criterion for distinguishing meteorites than differences of composition. On the other hand, similarity of structure and composition together do not positively identify meteorites found at different places as belonging to one fall, since such similarities occur in meteorites seen to fall at widely different times and places. Of the nine iron meteorites seen to fall, four are medium octahedrites and have practically similar compositions. In correlating individual meteorites, therefore, all possible characters must be taken into consideration, including the circumstances of their find, the appearance of their exterior, the probable time elapsed since their fall, etc.

No attempt has been made by the writer at summation of the analyses here given, in order to determine the average composition of iron meteorites. Such a summation, if worthy of being performed at all, will be deferred until analyses of the iron-stone and stone meteorites are also at hand for comparison. This work the writer hopes to accomplish in the near future. It is obvious, however, from an inspection of the tables that the average percentage of iron in iron meteorites as a whole is not far from 91 per cent, while that of nickel closely approximates 7.50 per cent. It is doubtful if the average percentage of the remaining minor constituents can be learned by summation of existing analyses. Not only have these constituents in many cases not been determined, but also any slight error in analyses or sampling would double or multiple their percentage. A percentage of .4 of cobalt, for instance, as compared with .2, is within the limits of error of many analyses, yet one percentage is double that of the other. The same is true in much greater degree of determinations of the amount of copper and other constituents. Until a larger number of complete and accurate determinations are at hand, therefore, summations of these constituents seem to have little value. One point in the composition of iron meteorites which may or may not be of significance may be noted. Of the four constant metallic constituents, the most abundant, iron, has the lowest atomic weight, the next in quantity, nickel, is next higher, and so on for cobalt and copper. This gradation, using percentages common in iron meteorites, appears as follows:

	Iron.	Nickel.	Cobalt.	Copper.
Per cent in iron meteorites	90	9	0.9	0.02
Atomic weight	55.5	58.3	58.6	63.1

METEORITE STUDIES II

BY

OLIVER CUMMINGS FARRINGTON.

BATH FURNACE.

Of the three known stones of this fall, one-half the smallest one, weighing 223 grams, came into the possession of the Museum (Mus. No. Me 570). This individual is of irregular disk-like form, of $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$ inches dimension. A side and front view of it are shown in Plate XXIX. Though its shape indicates that it was a scaling, it was completely encrusted and shows orientation. One of the broad surfaces was plainly the front side, the opposite the rear side. The front side shows lines of flow radiating from an eccentric point. These lines have under the lens the form of ridges of inverted V shape gradually branching and tapering out. These ridges are of shining black glass and rise above a dull-black ground. The interior substance of the meteorite is gray with rusted spots about the metallic grains. It is of sufficiently firm texture to take a good polish. Under the microscope the crust is seen to be relatively thin, .2 - .3 mm. The zones of Tschermak are indicated, but are by no means well marked. For the most part the crust appears as a black, opaque aggregate bordering the edge of the section, with here and there transparent grains of various sizes seen in polarized light to be unaltered olivine. The remainder of the section appears in ordinary light a confused mass of transparent grains considerably iron stained and interspersed with metallic grains of very irregular but usually elongated shapes. Among these troilite is more numerous than nickel-iron. An opaque, black substance also occurs in small quantity connected here and there with the metallic grains. It may be of ferrous or carbonaceous nature. Chondri are but occasionally and imperfectly outlined. In polarized light the chondri can be more readily recognized. They are not numerous, however, the greater part of the section being made up of anhedral grains of various sizes. Chondri where visible are for the most part sharply outlined from the surrounding mass. Those composed of alternate lamellæ of olivine and glass are the most common and next in number are those composed chiefly of fibrous enstatite. Large

chondri composed of porphyritic anhedral olivines or of olivine and enstatite also occur. These olivines frequently reach a length of .2 - .3 mm. and have well-defined prismatic outlines. The interstices between the crystals are usually filled with a turbid glass. The outlines of these chondri as a rule are less well-marked than are those composed of olivine and glass. Most of the chondri have spheroidal outlines, though a few fragmental forms occur. Among the constituents of the general mass, lath-shaped crystals of enstatite .3 - .5 mm. in length, with cleavage parallel to the direction of length are the most conspicuous. These and the enstatite chondri are sufficiently numerous to indicate a large proportion of this mineral in the constitution of the mass. Besides enstatite, grains of olivine of various sizes and outlines are to be seen in considerable quantity.

Plate XXX, from a photograph made by the writer about six months after the fall, shows the place of fall of the 178 lb. mass. The point was the base of the tree in the foreground. The meteorite in falling grazed the tree at the right, leaving a scar the observation of which by a squirrel hunter led to the discovery of the mass. Erection of a pole connecting the scar and the place of fall of the meteorite seemed to the writer to indicate a nearly vertical direction of fall. Miller,* however, estimated the angle to be 77° with the horizon, or 13° from vertical. The large roots of the tree prevented the stone from going deeply into the soil, and it was found resting on them. Considering the weight of the mass and the distance of its fall it is remarkable that it was not shattered by the impact and that the roots on which it fell were not more deeply bruised.

CHUPADEROS.

The two known masses of this meteorite were found, as was stated at an early period, lying only about 800 feet apart. This proximity and the jagged surface to be found on each renders it very probable, as was suggested by Daubree,† if not earlier by others, that the two pieces once constituted a single mass which was torn apart during its tall to the earth. The probable dimensions of this mass were given by Daubree as follows: Length 4.65 m. (16 feet), width 1.50 m. (5 feet) and thickness 0.45 m. (22 inches). The dimensions thus obfained by Daubree were evidently arrived at by assuming a joining of the two masses end to end. Such a joining, however, would not place the torn surfaces together. In order to determine what the form and

* Science, 1903. N. S. Vol. XVIII, p. 244.

† Comptes Rendus, 1889, Vol. CIX, p. 726.

dimensions of the mass would have been if the two parts were joined along the fractured surfaces, the two full-sized models of these masses in possession of the Museum were joined in this way. The resulting form is shown in the accompanying plate. (Plate XXXI.) It is seen to be broad and tabular with irregular outline. Along the line where disruption took place there was an evident constriction. The correspondence between the broken surfaces is such as to leave little doubt that they were once joined. The dimensions of the mass so formed are: Length 12 feet (3.6 meters) and width 7 feet (2.1 meters). The weight of this mass would have totaled about 21 tons (20,881 kgs.). It would be of interest to know which surfaces of the two masses lay uppermost when found, but no record seems to have been made of this point. There is a marked difference in the pittings on the two broad surfaces and they correspond on the two masses when joined. Thus pittings on the side shown in the accompanying plate are deeper and narrower than those on the opposite side. The indications are therefore that the side shown in the accompanying plate was the front side in falling.

As the writer is not aware that any photographs of the two original masses have ever been published, the accompanying cuts (Plates XXXII-XXXIII) from photographs made by him in 1896 are presented. These show the masses as they are installed in the National School of Mines in the City of Mexico. With them, as installed, are placed the Concepcion (Adargas) and Zacatecas meteorites. The large Chupaderos and the Concepcion masses are installed at one side of the entrance of the School of Mines (Plate XXXII) and the smaller Chupaderos and the Zacatecas masses at the other side of the entrance (Plate XXXIII). In Plate XXXIV is shown the Morito (San Gregorio) mass which is likewise installed at the School of Mines, and of which a photograph was made by the writer at the same time. This is a beautifully oriented meteorite and, as will be seen, has been mounted in the position it assumed when falling.

IRON CREEK.

A cast of this meteorite recently received by the Museum (Museum No. Me 763) through the kindness of the Geological Survey of Canada affords an opportunity for the study of some features which have not previously received description. The meteorite is remarkable for its orientation, the characters of front and rear sides being shown very plainly. In perfection of form in this respect it equals the Cabin Creek meteorite, which in general shape it resembles. In previous de-

scriptions of this meteorite* it has merely been stated that the mass was "irregularly triangular and much broader than thick"—and no dimensions have been given.

The form of the Iron Creek meteorite, as seen from its cast, is that of a low cone, 8½ inches (22 cm.) high and 22 inches (56 cm.) in diameter. The outline of the base of the cone is an incomplete circle, an approximately straight contour cutting off one side so that only about three-fourths of the circle is present. The width of the mass in this direction is 17 inches (43 cm.) Were the circle complete the apex of the cone would occupy a position near its center, but with the mass shaped as it is the apex is situated close to the straight side. At one point where the straight side joins the circular outline there was evidently, in the original mass, a prolongation perhaps a few inches in length, which having formed the most convenient part of the meteorite for removal has been sawed off for purposes, doubtless, of analysis and distribution. While the form of the meteorite as a whole is conical, it is also arched, the base being concave and the sides convex. The greatest depth of the concavity of the base is about one and a half inches and occurs opposite the apex. This general concavity is also subdivided by two secondary concave areas, one about seven inches (18 cm.), the other about ten inches (25 cm.) in diameter. These are again subdivided by broad, shallow pits from two to four inches in diameter. The perimetral edge formed by the meeting of the sides and base is irregular in contour and from one to two inches in thickness. The broad, shallow pits of the base, which by their form characterize this as the rear side of the meteorite are, as has been stated, from two to four inches (5-10 cm.) in diameter. Their form is approximately circular although they at times tend to be oval or polygonal. The ridges between the pits are low, rounded and merge into the pits. The pits of the convex surface of the meteorite present considerable contrast to these. They are smaller, rarely exceeding two inches (5 cm.) in diameter, are deeper in proportion to their diameters, more irregular in shape and the ridges between them are higher. They lack uniformity of shape or arrangement. Some are long and narrow, others three-sided, others again more nearly circular. The apex of the cone appears to have been less oxidized than the rest of the mass, indicating that the crust had sprayed off at this point. It presents a smooth surface about two inches (5 cm.) in diameter, convex except for a small, saucer-like depression about ½ inch (1 cm.) in diameter in its center. The base and the sides of the cone meet in a sloping edge except on the side already described as approximately

*1887 Proc. Trans. Roy. Soc. Canada, Vol. IV. p. 97.

straight. Here a broad flat surface is presented, perpendicular to the base of the cone or as if a section had been cut through the cone at one side of the apex and removed. The pittings of this surface resemble furrows and run in general, parallel to the axis of the cone. Some, however, converge from points on the side toward the central point of the base. This is the course which currents of air rushing from the front side backward to the partial vacuum behind might be expected to take. The characters above described make it clear that the convex surface with its deeper, smaller pits was the front side of the meteorite in falling. The characters of the crust cannot be determined from the cast nor are minute drift phenomena, if any occur, to be seen. Brezina, however, states* that the rear side has a bark crust 0.5 to 1 mm. thick. The plate accompanying the present paper (Plate XXXV) shows the characters above described. The adoption by the writer for this meteorite of the name Iron Creek instead of the more usual one of Victoria is on account of information received from Mr. Johnston of the Geological Survey that the small mission station of Victoria, from which the meteorite received that name, is one hundred and fifty miles from the locality where the meteorite was found, and it is no longer known by that name, its present name being Papan. Iron Creek is a well-defined stream only twenty-five miles in length, which takes its name from the fact that the meteorite was found near it. Iron Creek, moreover, is the English translation of the Indian name given to the stream before the white man entered the country. The meteorite was known to the Indians and held in great veneration by them.

LAMPA, CHILE.

Among a number of meteorites obtained by the late Professor Henry A. Ward in Chile in 1905 one was placed by Professor Ward in the hands of the writer for description. The only information given the writer by Professor Ward at that time was that the meteorite had been handed to him by some one at the School of Mines at Santiago. On corresponding with the School of Mines, the Director, Señor A. Orrego Cortes, kindly informed the writer that the meteorite had been found in the Sierra de Chicauma near Lampa. The latitude of the locality is 33° 15′ S. and the longitude 71° W. The height above the sea level is 1000 metres. Señor Cortes also stated that other specimens of the find aggregating 5-6 kilograms in weight had been preserved.

The meteorite is of the stony variety. From the locality it would seem to be a different fall from any yet described. The material pro-

* Wiener Sammlung, 1895, p. 279.

cured by Professor Ward was a single individual about 10 x 15 cm. in size. When received by the writer, however, the mass had been broken in two parts. The smaller of these parts had been sawed in two, and one surface of one polished, while the other part was missing altogether. It is impossible, therefore, to state what the exact original form and weight of the mass was, but it is not probable that the missing part exceeded one pound (453 grams) in weight. The total weight of the parts in hand amounted to 6¼ pounds (2.8 kgs.). Continuation of the contours of the two portions in hand gives a pretty accurate idea of the original form, the space probably occupied by the missing portion being indicated in Plate XXXVI. The original form of the mass was evidently that of a short cylinder about six inches (15 cm.) in diameter and four inches (10 cm.) in height. The surface of one end of the cylinder tends to be convex and that of the other concave. These differences of curvature together with distinctions in crust and pittings show pretty conclusively that one was the front and the other the rear side of the meteorite in falling. On the front and rear surfaces of the meteorite the primary crust is pretty uniformly present. On the sides, however, it appears only at intervals, indicating that during the fall of the meteorite to the earth, or since its arrival, portions have been broken off. How much has been separated in this way it is obviously impossible to determine, but it is quite probable that at one time the mass had a more disk-like shape than at present. The surface of the front side of the meteorite is very smooth and varnish-like. There are no well-marked pits to be seen, the nearest approach to them being three or four shallow, irregular depressions about one inch (2.5 cm.) in diameter. The color of this surface is in general a dull hematite-red, shading to darker about the edges of the meteorite. The smoothness and color give an appearance much as if the surface had been coated with a red varnish. The most remarkable feature of this front surface is a system of cracks or fissures which transverse it. These cracks appear to be quite independent of the contour of the surface. In general they may be said to mark triangular areas, the sides of the triangles being about two inches (5 cm.) in length. In width the fissures vary, but rarely exceed one millimeter. As shown by sections and by pushing a wire into them they penetrate quite deeply into the mass of the meteorite, some being traceable an inch (2.5 cm.) below the surface. Their extension downward is usually in a slanting direction and not perpendicularly. Sections of the meteorite also show cracks running parallel with the surface at a distance of about one-half inch (1 cm.) below it, and others extend inward from the side and rear of the meteorite. The prominent

and visible cracks are, however, all on the front side. That these cracks are due to the necessity of a contracted exterior adapting itself to a larger interior there can be no doubt. Whether, however, their origin is to be ascribed to heating produced by the passage of the meteorite through the atmosphere and consequent contraction upon cooling, or to slower processes of weathering after its fall is not certain. Shrinkage cracks observed upon meteorite crusts at the time of fall are usually of a finer pattern than those here seen and penetrate little below the crust. The rusted character of the interior of this meteorite shows that it has long been exposed to the weather. The Doña Inez meteorite, which was exposed to similar climatic conditions, is described by Howell* as being deeply penetrated by cracks. The writer is therefore inclined to regard the cracks in this meteorite as due to a slow hydration of the interior of the meteorite, such as would be favored by an arid climate. In such a climate, water penetrating into the interior of the meteorite through minute interstices would be held and cause hydration, while from the exterior it would soon dry away. Minute cracks would thus become wedges which would gradually split the meteorite open. The crust of the front side while in general smooth, shows irregular patches and clots of fused matter abundantly distributed over it. These patches are in general darker than the surrounding crust. They are less than ½ millimeter in thickness and a few millimeters broad. They grade, however, into grains which scattered over the surface produce a stippled appearance. Drift phenomena are lacking except, perhaps, for a slight divergent arrangement of grains leading out from one or two of the pits.

The rear side of the meteorite as received showed a whitish coating in many portions. This effervesces and can be removed by acid and is doubtless a carbonate of lime similar to that often observed on meteorites which have been exposed for some length of time in arid regions. When this coating is removed the true crust can be seen. This is in part black and in part red, but always scoriaceous. It is probable that the red color is due wholly to rusting and that the original crust was black. The texture of the crust as seen under the lens is quite uniform and minutely cellular throughout. Minute ridges and hollows and partially opened blebs indicate fusion with the production of gas bubbles. This crust shows a tendency to flake off as a unit when struck with a hammer. It thus has the characters of Brezina's "bark crust." The pittings of this surface are broad, shallow, saucer-shaped and confluent. Their diameters average about one

*Proc. Rochester Acad. Sc., 1890, Vol. 1, p. 93.

inch (2.5 cm.), and as the ridges between them are but slightly elevated they give the surface an undulatory character.

The surfaces intermediate between front and rear show in general transitional crust characters. The crust is more uniform, less scaly and thicker than on the front side and less scoriaceous than on the rear. The edges by which the sides join the front and rear are in general rather sharp but somewhat rounded. One of these side surfaces is a plane, about two square inches (4 cm.) in area, at right angles to the long axis of the meteorite. The clots of fused matter are much thicker and narrower on this face, making it quite rough. Only one other broad side surface occurs. This is concave and has a smooth crust more nearly like that of the front side but thicker. Those surfaces showing no primary crust, but which were original on the meteorite at the time of its finding, are rough from fracture, but a rounding off of the protruding grains has taken place. It is probable that the meteorite broke during its descent to the earth and these surfaces were somewhat glazed over.

The interior of the meteorite presents a compact, homogeneous appearance. In color it is a chocolate to reddish-brown, thickly dotted with metallic grains which show upon a polished surface. It is probable that the present color is largely the result of staining from rust, and that the original color is in no place preserved. The metallic grains are quite minute, few reaching a millimeter in any dimension. They appear uniformly but not very abundantly distributed. To the naked eye no chondritic structure is visible either upon a fractured or polished surface. Under a lens, however, circular spots now dark and now light, but for the most part darker than the prevailing color indicate the presence of chondri. The compact appearance of the meteorite likewise disappears under a lens. The whole surface of a polished mass is then seen to be thickly sprinkled over with minute, irregular holes, which may join or be isolated. These cavities may be in part due to the falling out of grains, in the process of polishing, but as their borders frequently show a coating of limonite, it is probable that many represent an original cellular structure, or are due to weathered-out constituents.

The specific gravity of the meteorite, obtained by weighing a piece of 557 grams, was found to be 3.4005.

Crust sections are of interest in showing a structure different from that usually seen. The crust microscopically shows two well-marked zones. The outer, .1 mm. thick, is opaque and blebby. The inner, .3 mm. thick, has a microlitic structure with occasional rounded crystals of olivine. It is semi-opaque, presenting a gray appearance as

compared with the dark-brown to black of the outer zone. These microlites have an elongated form, averaging about .02 mm. in length and tend to a fibrous structure. Succeeding to this inner zone, while no structural change is apparent as compared with the interior of the meteorite, there is a marked series of cleavage or fracture lines running essentially parallel to the crust. These lines, although irregular and frequently anastomosing, run at intervals of about .05 mm. The zone showing these lines has a width averaging about .2 mm.

As regards the remainder of the section, in ordinary light a field of silicate and metallic grains is presented, with the siliceous constituents exceeding the metallic. There is considerable limonitic staining of the silicates and the metallic grains are for the most part bordered by a dark zone of the same character. Chondri of spheroidal outline occur here and there, but are not abundant. They are rather uniform in size. Their diameters vary from .5 to 1 mm., being generally about .7 mm. In structure they present chiefly the familiar ribbed and porphyritic characters produced by combinations of chrysolite and glass. The general form of the chondri is spherical but many are plainly fragmental. In outline the chondri are rarely sharply separated from the adjoining ground mass, although this is sometimes the case. The ground mass of the meteorite exclusive of the chondri is made up of crystalline fragments varying from minute grains up to individuals .3-.4 mm. in diameter. Many of the larger individuals show crystal outlines which are more or less rounded. High interference colors and strong double refraction show these to be chrysolite for the most part. The larger individuals are traversed by cleavage cracks along which alteration has frequently taken place. This appears in the form of brownish opaque bands which suggest iddingsite traversing the fragments. Aside from these the crystals are free from clouding or inclusions for the most part. One interesting crystal, however, has an outer transparent portion, while the interior shows glass and skeleton growths. The metallic grains consist of nickel-iron and troilite, sometimes singly and sometimes in combination. They have irregular branching forms and seem to fill the interstices between the silicate grains. Their form shows beyond a doubt that they were subsequent in origin to the silicates.

MEJILLONES.

Through an error of the writer in copying Wulfing's classification, the specimen of this meteorite in the Museum collection was designated * as a brecciated hexahedrite. It is in fact an iron-stone meteor-

* Pubs. Field Col. Mus. 1903. Geol. ser. Vol. II, p. 107.

ite and probably a mesosiderite. The error of notation would not have been significant but for the fact that the accompanying description was copied by Cohen* in his account of the brecciated hexahedrites. Under the name of Mejillones two masses of different characters are now to be found in collections, as was early noted by Meunier.† Meunier recommended the name of Pseudomejillones for the iron-stone fall. As such a nomenclature would, however, not be in accordance with present usage it would seem sufficient to designate one as Mejillones, iron, and the other as Mejillones, iron-stone, at least until some further information can be obtained regarding the origin of the masses. It is not impossible, indeed, that they may be parts of the same mass with different structures, as occurs in many pallasites. Of Mejillones, iron, but a small quantity seems to be known. Of the specimens listed by Wulfing‡ under this name, those of Harvard and Ward are iron-stone. The Harvard specimen was obtained by purchase from Ward and Howell§, as was also the specimen in this Museum. Excluding these it leaves the specimen in the Paris collection as perhaps the only well-authenticated one of the Mejillones iron. This specimen according to Meunier was received from Domeyko.

MODOC.

This meteorite has already been made the subject of a brief note‖ and detailed study ¶ by Merrill and a note by the present writer.** Some additional facts obtained by the writer during a visit to the locality in February, 1906, and by study of specimens seem worthy of record. These observations include accounts of the phenomena of fall obtained from various residents of Modoc, also at Tribune, forty miles west of Modoc. The accounts at the latter place show a much shorter interval to have intervened between light and sound than at Modoc. This seems conclusive evidence that the meteor exploded over Tribune and traveled about forty miles before falling. The accounts here given are arranged in the order of the position of the observers going eastward.

Mr. Raines, the station agent at Tribune, was about to lower a curtain at an east window when he saw the meteor at the north going

* Meteoritenkunde, Heft III, p. 233.

† 1893. Revision des fers meteoriques, p. 75.

‡ Die Meteoriten in Sammlungen, p. 230.

§ Huntington, Catalogue of all recorded meteorites, 1887, p. 93.

‖ Science 1906, N. S. XXIII, p. 391.

¶ Am. Jour. Sci. 1906, (4): 21, pp. 356-360.

** Science 1906, N. S. XXIII, p. 582.

eastward. Its appearance was that of a ball of fire, resembling an electric light in color and of the size of a "wash tub." In a short space of time, probably two or three seconds, it exploded, throwing out sparks and then disappeared, leaving no trail behind it. In about 30 seconds three muffled reports and a continuous roar like thunder were heard.

Mr. P. W. Grimes, of Tribune, was sitting with his head down, facing west, when a light like that of an electric light attracted his attention. He saw a ball of fire to the north, traveling east. The light lasted two or three seconds and in about 20 seconds came three muffled reports like those of thunder.

Mr. Willie Baugh was driving south about two miles from Modoc. He saw a light to the west, resembling an electric light, seemingly falling towards him. Then it seemed to describe an upward path and exploded, sparks going in different directions like those of a Roman candle.

Mr. and Mrs. W. E. Curtis, of Modoc, had retired for the night when Mrs. Curtis was awakened by a light so bright that she thought the barn was afire. This light was followed by three reports like thunder and a sound like the wind coming up. She awakened Mr. Curtis, who went to the porch, and then heard sounds like hailstones falling. The fall of each stone was accompanied by slight hissing sounds. Next morning Mr. Curtis found a stone weighing about one pound in his yard, and others later.

Mr. and Mrs. Fred Yost, living only a few rods from Mr. Curtis heard a sound like accentuated thunder, but saw no light nor heard any stones falling. They found several stones about their premises later.

Mr. Schirmeyer, of Modoc, was in doors. He saw a light at an east window and stepped out on the porch to examine it. Two or three explosions like rifle shots followed, also swishing sounds like the dropping of stones. Rumbling sounds then died away to the west for about five minutes.

Mr. Irwin, of Modoc, saw a light below a partially lowered curtain. He called to his wife to see what was going on. She got up for a moment and then retired again; and then came sounds which led them to think that a smashup had occurred on the railroad near by.

Mr. T. D. Marshall was coming up out of his cellar at the time of the fall. His attention was attracted by a bright light in the sky, which was followed by a sound like four beats on a bass drum and others like the swish which accompanies the shooting of a rocket. He then heard stones striking in a number of places about his house. He expected to

be able to find a number of these the next morning, but on searching succeeded in discovering only one.

Mr. McDonald heard sounds like the firing of a machine gun, and a few days later found a small stone about 100 feet from his house.

Mr. J. K. Freed heard sounds like those of a machine gun.

Inhabitants of Scott, about four miles east of the place of fall, generally described the sounds as like those of a wagon traveling over a bridge.

An account of the occurrence published in the local paper, the Scott County Chronicle, Sept. 8, 1905, six days after the fall, was as follows:

"Last Saturday night about 10 o'clock a remarkably bright meteor was seen in the heavens west from this city. It was almost as light as day. The explosion occurred in the vicinity of Modoc and was heard clear across the county. T. D. Marshall had a piece of the meteor in town Wednesday which he found near his house, which is black on the outside and gray on the inside, and is heavily charged with metal indicating silver and gold. It is reported that W. E. Curtis and a man named Pence have found pieces that show that the remnants were scattered over several miles of territory. Mr. Marshall says the commotion in his territory was simply terrifying."

Under Modoc items an account was given in the same paper as follows:

"Last Saturday night about 9 o'clock a meteor passed over this locality. It was followed by a roar that sounded like thunder. It probably bursted, as fragments were heard falling by several persons and T. D. Marshall and W. E. Curtis each found one. The parts found were dark lead color, almost black, and give a metallic sound when struck. They are checked by small cracks indicating an extremely heated condition while passing through the air. They weigh but a few ounces, yet are prized by the finders as they probably represent part of some planet far away, and have traveled for millions of miles through space before finding a resting place on Earth."

The difference in time of these two accounts is accounted for by the fact that in Modoc, Mountain time is used, but in Scott, Central time.

The area over which the meteoric stones were found was one about seven miles by two, the longer distance extending east and west. The region is a rolling prairie, rather thinly inhabited. Much of the area has never been plowed. The native sod, or "buffalo sod," as it is often called, proved comparatively impenetrable to the stones which fell upon it. A slight indentation in the sod showed plainly where a stone weighing 7 pounds, found by the writer, had struck. The ground also

was bare at that point, showing that the grass had been killed. The meteorite did not lie at the point where it had struck, however, but about its own width (four inches) to the south. It had thus evidently bounced southward on striking. Mr. McDonald, of Modoc, informed the writer that the stone which he found had also bounded southward. Mr. Freed, of Modoc, informed the writer that the stone which he found had penetrated the sod about four inches. This was of tabular form and was on edge. It weighed 11 lbs.

The following list shows the individual stones which had been found at the time of the writer's visit and the names of the finders. All of these masses were seen by the writer. The weights are in several cases approximate only. Those that are known accurately are given in grams.

	Weight.	*Finder.*
1.	10¾ lbs. (4,640 grams)	J. K. Freed.
2.	7 lbs. (3,171 grams)	O. C. Farrington.
3.	5 lbs.	F. P. Heller.
4.	2 lbs. 10 oz. (1,170 grams)	F. P. Heller.
5.	1 lb. 15 oz. (879 grams)	F. P. Heller.
6.	1 lb. 6 oz. (624 grams)	John March.
7.	1 lb. 1 oz. (490 grams)	Fred Yost.
8.	14 oz.	—McDonald.
9.	12½ oz.	W. E. Curtis.
10.	10 oz.	T. D. Marshall.
11.	6 oz.	Fred Yost.
12.	6 oz. (170 grams)	Fred Yost.
13.	6 oz.	Mrs. W. E. Curtis.

In addition the find of an individual weighing 1½ lbs. was reported by O. L. Douglass, and of one weighing 2 lbs. by F. P. Heller. Thus a total of at least fifteen stones has been found, having an aggregate weight of about 35 lbs. (16 kgs.).

The distribution of these specimens over the area in falling shows a remarkable gradation in accordance with their size. The stones fell in order of their weight from west to east. This is graphically shown in Plate XXXVII. The two individuals weighing 1 lb. and 2 lbs. each found in the vicinity of the 5 lb. mass are fragments, the remaining portions of which were not found although extended search was made, and the region is exceptionally favorable for searching for meteorites. The smooth buffalo sod has no other stones upon it and the vegetable growth is not sufficient to hide stones of appreciable size. These fragmentary individuals are shown in Plate XL. The complete individuals would probably weigh about 5 lbs. each. Some of the non-crusted surfaces of these show blackening while others are perfectly

fresh. The completely encrusted individuals are of irregular, angular shapes, with angles slightly rounded, as is usual in meteorites. Several, however, show projecting spurs of toothed form which are unusual. No. 10, Plate XXXIX, is especially notable for these. The three views given of this individual show its orientation. The broad surface with rounded shallow pits was the rear side, the opposite the front side. As shown by the side view, the individual is fragmentary.

The individual found by the writer, shown in Plate XXXVIII, has a roughly tetrahedral form with one of the faces of the tetrahedron broken up into three planes. The faces are nearly all slightly concave and show only a few broad pittings. A marked feature of the surface is a whitish deposit occurring on several of the faces. This deposit is more or less streaked in appearance and the direction of the streaks is such that they would meet in a common point if produced. Examined under a lens the deposit is seen to be a fine powder embedded in the interstices of the slaggy crust. It is soluble without effervescence in hydrochloric acid but is so small in quantity that further determination of its nature cannot be made. The simplest explanation of its origin would seem to be to regard it an efflorescence due to weathering, as the meteorite had been exposed five months to the elements when found. The uniformity of direction of the streaks is somewhat difficult to account for on this hypothesis, however. One of the uppermost faces, moreover, is entirely free from the deposit. The deposit lies on what was undoubtedly the forward portion of the meteorite in falling and the radiation of the streaks from a common point suggests that it was made during flight. In either case the phenomenon is new to the writer's experience. The individuals shown in Plate XL were, as already stated, fragments when found, and no adjoining parts have yet been discovered in the vicinity so far as the writer is aware. The encrusted portion of one is seen to be deeply pitted, the pits varying in form and size on the different surfaces. On one surface they are abundant, small and uniformly distributed, on others fewer in number, larger and deeper. The complete individual was evidently of tabular form and about 2 inches (5 cm.) thick. One of the broad surfaces is remarkably flat and shows well-marked divergent lines of flow on the crust. The other individual shown in this plate illustrates the internal veins which occur in some specimens. These veins are evidently only armor faces produced by slipping. They are planoid in character and run in various directions which often intersect. The crust of most of the individuals is dull and coal-black in color, though of reddish tone in some individuals. Crackling of the crust into irregular polygonal areas is a common and characteristic feature,

as shown in several of the plates. The crackle has a mesh-like pattern with meshes in the form of polygons, squares and triangles from ¼ to ½ inch on a side. The appearance is entirely similar to that presented by crackled earthen ware and is doubtless produced by shrinking of the crust in cooling, or expansion of the interior of the meteorite subsequent to the formation of the crust. Another interesting feature seen on the crust of several individuals is that of glazed spots of occasional occurrence. The spots are usually of a greenish color, oval to circular in area, and vary from ¼ to ½ inch in diameter. They doubtless mark the location of chondri of fusible composition.

Under the microscope the crust shows in cross section a thickness of about .5 of a millimeter. The three zones of Tschermak are plainly marked, with widths averaging as follows: Fusion zone .025 mm., absorption zone .1 mm., impregnation zone .4 mm. These zones exhibit the usual characters, the fusion zone being black, opaque and glassy, the absorption zone transparent, and the impregnation zone showing a large proportion of black, opaque matter. The relative widths above given remain fairly constant, although in places the absorption and fusion zones are of about equal width, and again the absorption zone may disappear altogether. The fusion zone is at times also blebby and rough in outline. The interior of the meteorite is megascopically ash-gray in color, in some individuals flecked with rusty spots. The substance is only fairly coherent, and will not polish.

PONCA CREEK.

The writer proposes the name of Ponca Creek for the meteorite usually known as Dakota. The reasons for the change are as follows: The original account by Jackson* states that the fragment which he described was given him by the U. S. Indian agent for the Ponca tribe of Indians, and further that the mass was found on the surface of the ground "in the Dakota Indian territory, ninety miles from any road or dwelling." In the repetition of this statement by foreign authorities a comma came to be inserted after Dakota, so that the locality was known as Dakota, Indian Territory. There is no such locality, however, and Indian Territory is several hundred miles removed from the place where the meteorite was found. Moreover, the original territory of Dakota, within which the meteorite may have been found, is now subdivided into North and South Dakota and neither name would designate the locality in a sufficiently limited way. The reservation of the Ponca Indians, who were a tribe of the Dakotas and from whose agent

*Am. Jour. Sci. (2) 36, pp. 259-261.

the meteorite was obtained by Jackson, was at that time located along Ponca Creek in Nebraska. It seems reasonable to suppose that the meteorite was found in the vicinity of this creek, and the name Ponca Creek has the additional advantage of containing that of the tribe by some member of which the meteorite was probably originally found. For the meaningless name Dakota, therefore, that of Ponca Creek may well, in the opinion of the writer, be substituted.

SALINE.

Some further observations may here be added to the brief account of this meteorite given by the writer in 1902.* The approximate place of find of the meteorite was kindly indicated to the writer by Mr. S. A. Sutton, and this is shown in Plate XLI. No other observations of the fall than those already made by Mr. Sutton and reported by the writer seem to be known. The shape of the meteorite may be described as approximately that of a truncated, four-sided pyramid. The base of the pyramid, shown in Plate XLII, was plainly the rear side of the meteorite in falling. It is the broadest surface of the mass, and has an area of about 144 square inches (900 sq. cm.). In outline it is roughly circular. Mr. Sutton states that this was the surface on which the meteorite rested when found, but this position could have been brought about by an overturn when striking. It was more heavily coated with carbonate of lime when received at the Museum than any of the other surfaces. It is nearly flat, though slightly concave, and shows the broad, shallow pits characteristic of these surfaces of meteorites. On the opposite side of the meteorite a surface having the form of a long and narrow isosceles triangle runs nearly parallel to it and the thickness of the meteorite between the two surfaces ranges from 7 to 8 inches (18 to 20 centimeters). From the parallel surface the meteorite slopes away at angles of 40°, 50°, 60° and 90° approximately. Three of these surfaces are approximately plane, the others are rounded. A view of the meteorite showing this feature is given in Plate XLII. Views of the mass from two other sides were published in the Catalogue of Meteorites of the Museum.† The plane surfaces show practically no pits, the others are more or less irregularly pitted. The more symmetrical of these pits are oval in form, from ½ to ¾ inches in their longest diameter and have a depth about one-fourth as great. All the edges produced by the meeting of different surfaces of the meteorite are rounded.

* Science, N. S. Vol. XVI, pp. 67, 68.

† Pubs. Field Col. Mus. 1903, Geol. ser. Vol. II, Plate XXX.

Except where it has scaled off in small areas the meteorite is covered with a firmly adherent, dull brown-black crust, rough from the protrusion of thickly scattered metallic grains. These grains are darker in color than the rest of the crust, probably from a coating of iron oxide. When this coating is scraped away, however, the bright nickel-white color of the metallic grains is seen. One of the grains showed bright when the meteorite was received, but it may perhaps have become so through handling. It is the largest single grain to be seen. It has a hemispherical form and a diameter of 5 mm. The shapes of the other metallic grains as they protrude are various. Some are elongated, some nearly circular and others form small connecting groups. For the most part the grains are independent of each other, but there are two well-defined groups of them extending in irregular lines and standing out like veins. These are not straight in their course but nearly so. The extent of each is about 6 cm. (2½ inches). One runs from the large grain mentioned above, the other is nearly parallel to it 7 inches (18 cm.) distant.

Besides being broken by the protrusion of the metallic grains, the crust is seamed and fissured by numerous cracks extending in all directions and varying in extent and depth. The largest has a length of 6 inches (15 cm.), and from this to the minutest fissures all gradations occur. The course of most of the cracks is straight towards the interior of the meteorite, but some run so as to tend to scale off. They give the exterior of the meteorite a "baked" look and there can be little doubt that they are the result of differential expansion through heat of the interior as compared with the exterior. Scaling of the crust had occurred at various points when the mass reached the Museum. Many of these scalings must, on account of their freshness, have occurred very shortly before the meteorite struck the earth or from the force of impact. Most of the surfaces thus exposed were covered with an adherent coating of carbonate of lime when the stone was received at the Museum. The lime undoubtedly deposited more readily here on account of the increased capillary attraction afforded by such surfaces. The color of these surfaces was for the most part rusty brown from exposure, but a few were of a greenish-gray color where the carbonate of lime was freshly removed. In addition to these wholly uncrusted surfaces one about three inches square had a very thin black crust, much thinner than the average crust. It is evident that at this point a piece scaled off from the meteorite during its passage through the air and time sufficed for only a partial fusing of the freshly exposed surface.

Internally the substance of the meteorite when freshly broken is

of a greenish-gray color and firmly coherent texture so that it takes a good polish. Enough weathering has taken place, however, to give the interior in large part a dark-brown color. The percentage of metallic grains seen on a polished surface is large, so as to seemingly constitute about one-fourth the mass. The metal is uniformly distributed but the grains vary in size and shape. Some having a diameter of 4-5 mm. are discernible. At times they aggregate into vein-like lines. Both polished and unpolished sections show the interior of the meteorite to be penetrated by a great number of minute fissures arising probably from hydration. Most of them contain carbonate of lime which has doubtless been brought in by infiltrating waters. Such fissures, as well as the metallic "veins" are shown in an illustration published in the Museum Catalogue of Meteorites of 1903.* Under the microscope all the striking characters of the spherical chondrites are presented by the meteorite. Chondri of great variety of size and structure make up the principal mass. For the most part the chondri are spherical in form but some are oval and others of unsymmetrical outline. Besides complete chondri, fragments of chondri are to be seen. As was stated in the writer's first paper on the meteorite, enstatite and olivine either singly or in combination chiefly compose the chondri. Diameters of from .3-.6 mm. are presented as a rule by the enstatite chondri, but one 3 mm. in diameter was seen in one section. Several of the half-glassy chondri show rounded depressions as if made by the pressure of another chondrus. The olivine chondri are both monosomatic and polysomatic, also porphyritic and lamellar. In dimention they vary as widely as do the enstatite chondri and between about she same limits. The porphyritic individuals of the chondri show, as a rule, well-marked prismatic outlines. Crust sections under the microscope fail to show, except for an outer fusion zone, well marked zones such as are common in the more porous chondrites. The fusion zone is of a dark, nearly opaque, somewhat blebby and glassy nature and has a thickness of about .08 mm. Succeeding this, towards the interior of the meteorite, a zone about .4 mm. in thickness shows scattered opaque impregnations interspersed among unaltered olivine crystals. This zone is not uniform in occurrence, however, and can be seen only at intervals.

WESTON.

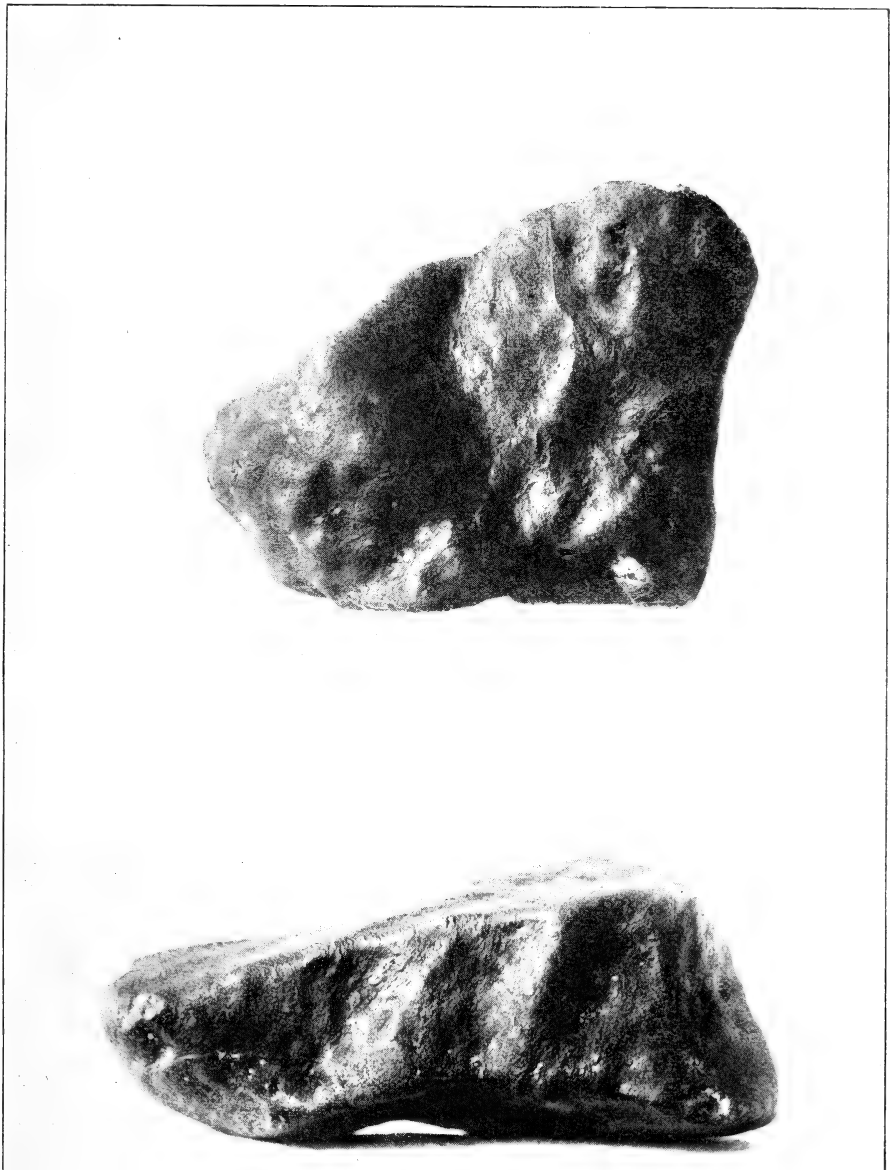
In connection with the meteorite fall which occurred at Weston, Connecticut, December 14, 1807, a well-marked distribution of the masses according to weight took place to which attention does not

* Pubs. Field Col. Mus. Geol. ser. Vol. II, Pl. XXXI.

seem to have been called in detail hitherto. In Silliman and Kingsley's account* the fact is noted that stones fell from the meteorite at six different places, over an area 9 to 10 miles in length. It is stated by these authors that these masses fell in a line differing little from the course of the meteor, and probably in the order of the most northerly first and the most southerly last. The relation of the weight of the masses to this order was not traced by these authors, however. This relation as shown by the subsequent account is as follows:—The most northerly fall (near Mr. Burr's) broke into fragments from striking a rock of granite. Its estimated weight was 20-25 pounds. The next fall was at Mr. Prince's, five miles south from Mr. Burr's. This stone weighed 36½ lbs. About half a mile northwest of this, however, one was found weighing 7-10 lbs. and half a mile northeast one weighing 13 lbs. These two masses were doubtless related to the 36 lb. mass. The next mass in a southerly direction was found two miles southeast of Mr. Prince's at Mr. Porter's. This was also broken but is regarded as having weighed from 20 to 25 lbs. and was probably also related to the 36 lb. mass. The largest mass of all fell near Mr. Elijah Seely's, about four miles from Mr. Prince's. The direction of this locality from the others is not stated, but from the context there can be little doubt that it was south. This mass weighed about 200 lbs. The distribution of the masses thus shows a distinct arrangement according to weight and direction. As Bowditch† determined by an independent investigation that the course of the meteor was South 7° West, it is evident that the smaller stones fell first. The distribution of the masses, as above noted, also accords with the statements of several witnesses at the time that the sound of three separate explosions accompanied the passage of the meteor. The smaller masses near Mr. Prince's were evidently thrown off at the time of the second explosion.

* Trans. Amer. Philos. Soc. Phila. Vol. 6, 1809, pp. 323, 325, 335-345.

† Mem. Acad. Arts and Sci. 1815 Vol. 3, pp. 213-236.



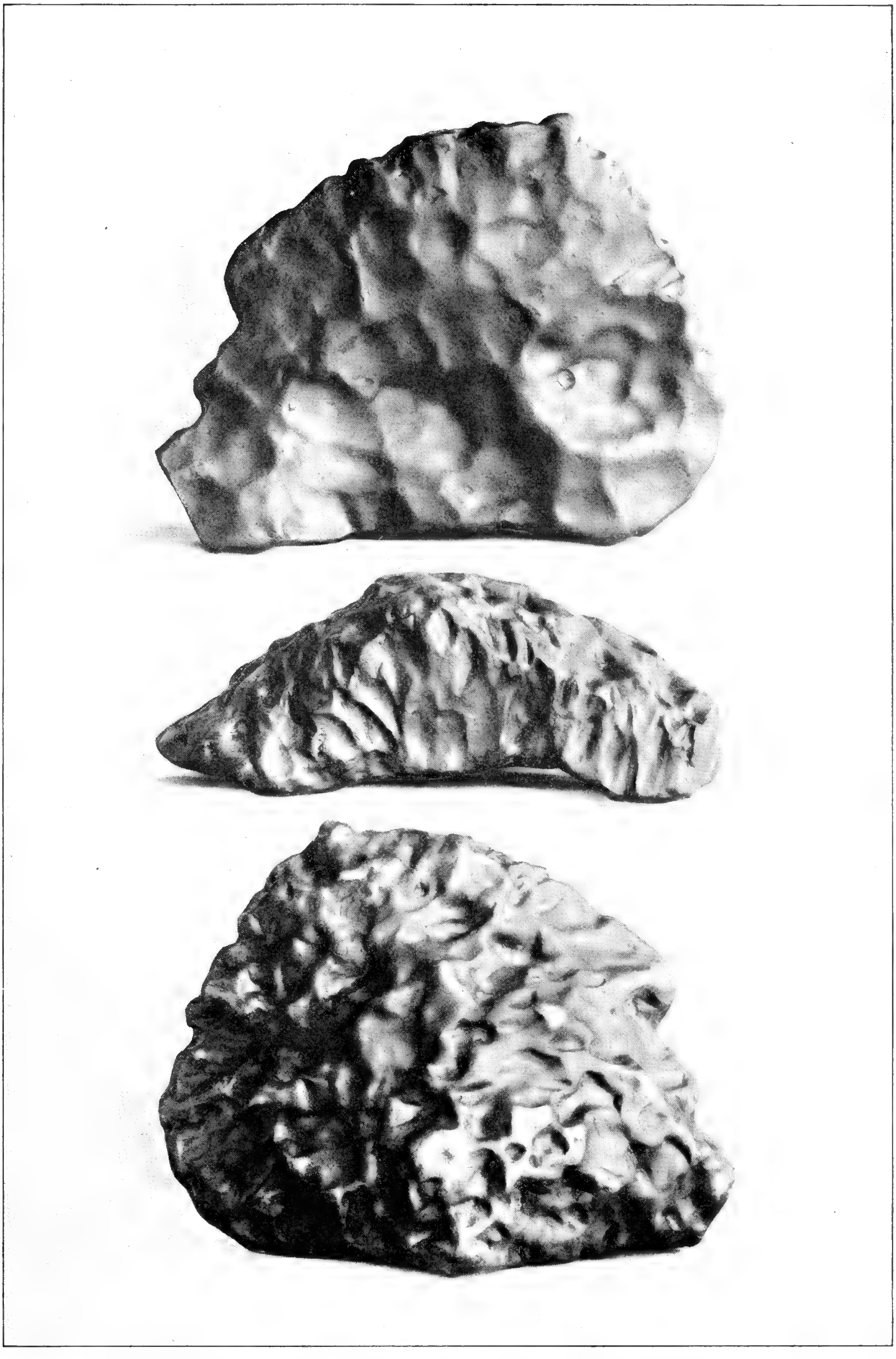
FRONT AND SIDE VIEWS OF SMALL BATH FURNACE METEORITE. x $1\frac{1}{2}$.

PLACE OF FALL OF THE 178-LB. BATH FURNACE METEORITE.

Concepcion and Chupaderos Meteorites. School of Mines, City of Mexico.

Chupaderos and Zacatecas Meteorites. School of Mines, City of Mexico.

MORITO (SAN GREGORIO) METEORITE. SCHOOL OF MINES, CITY OF MEXICO.



REAR, SIDE AND FRONT VIEWS OF CAST OF IRON CREEK METEORITE. X 1/7.

FRONT AND REAR VIEWS OF LAMPA METEORITE. X ½.

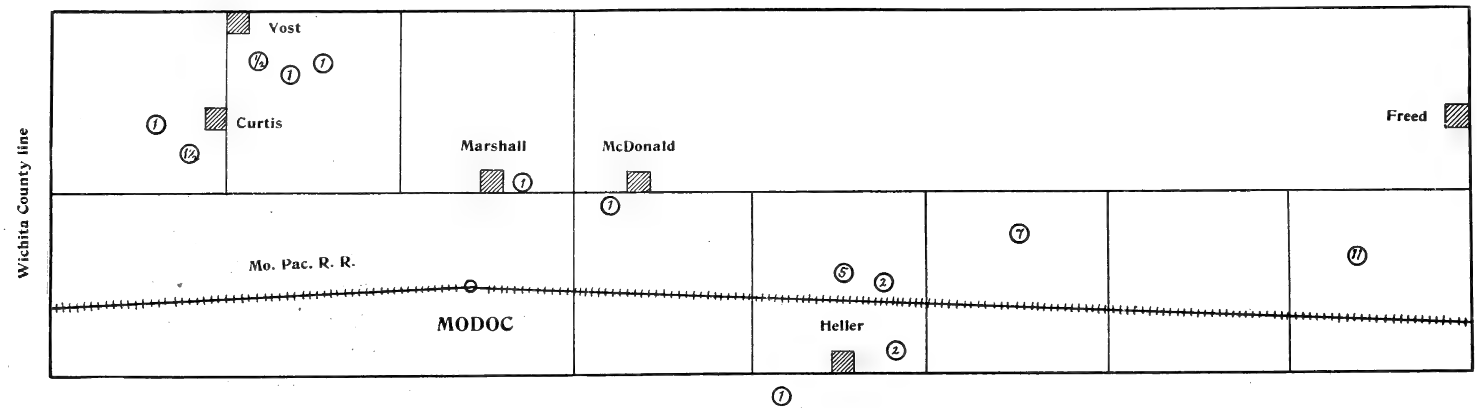
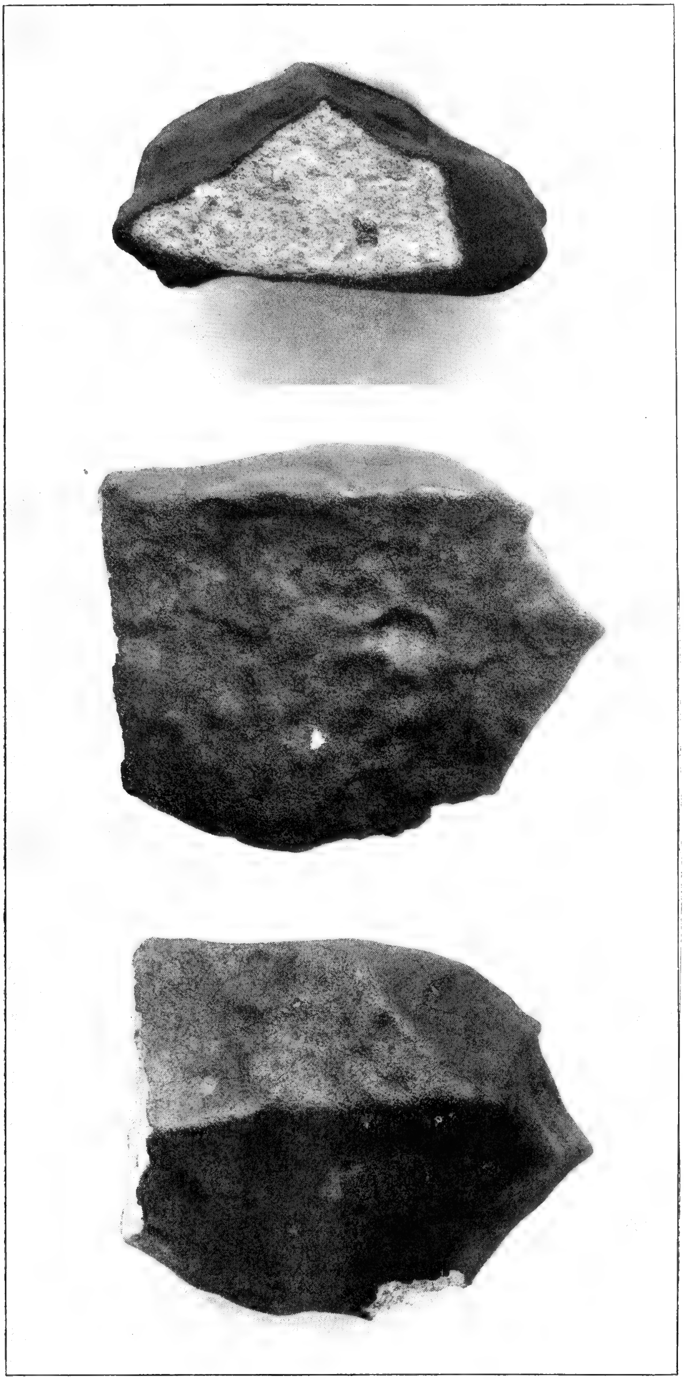
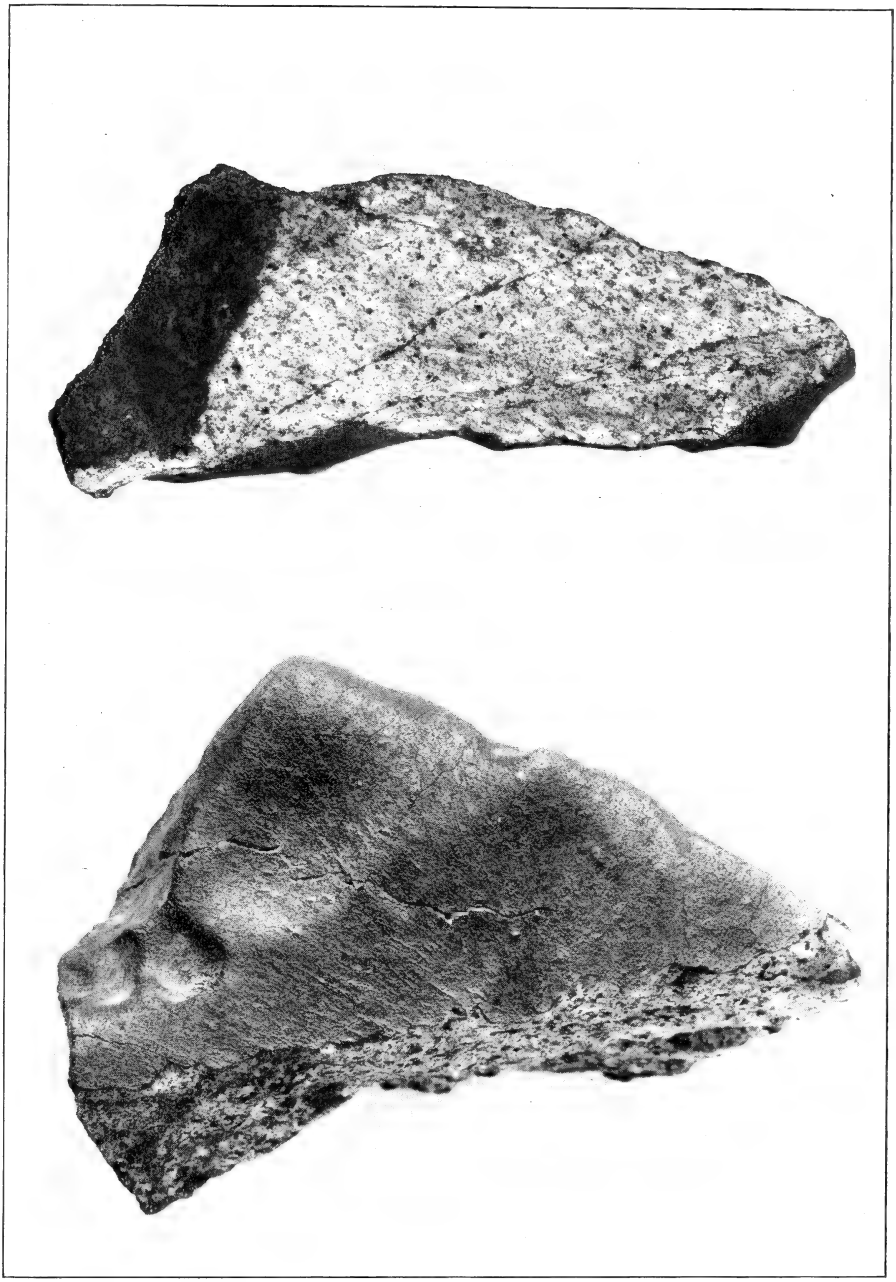


DIAGRAM OF DISTRIBUTION OF INDIVIDUALS OF THE MODOC METEORIC SHOWER. THE FIGURES IN CIRCLES SHOW THE WEIGHT OF THE INDIVIDUALS OR FRAGMENTS. THE SQUARES REPRESENT AREAS OF ONE MILE EACH.

FRONT AND REAR VIEWS OF 7-LB MODOC METEORITE. X $\frac{15}{16}$.



SIDE, REAR AND FRONT VIEWS OF 10-OZ. MODOC METEORITE. X $\frac{5}{6}$.



FRAGMENTARY INDIVIDUALS OF MODOC METEORITE. NOS. 5 AND 6 OF LIST. X $\frac{16}{17}$.

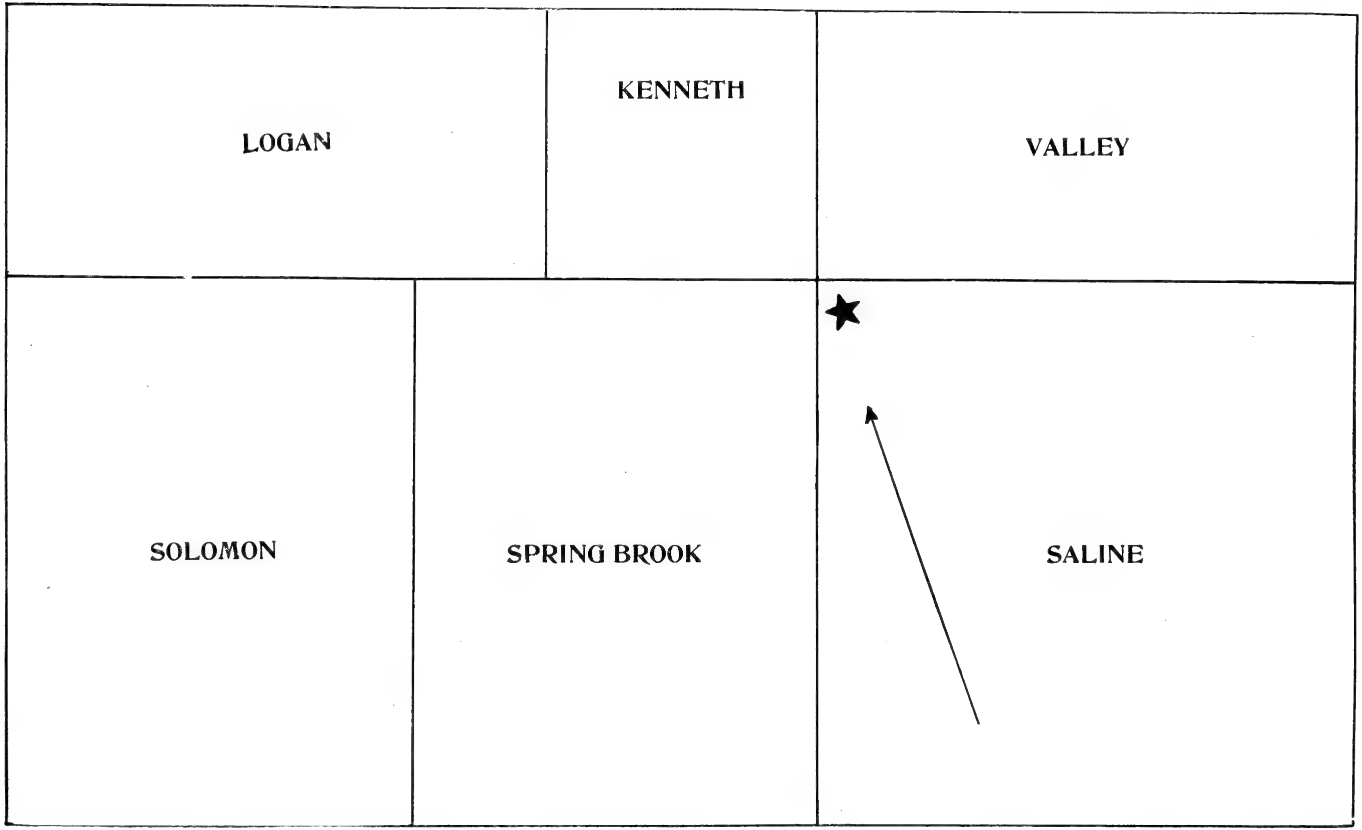
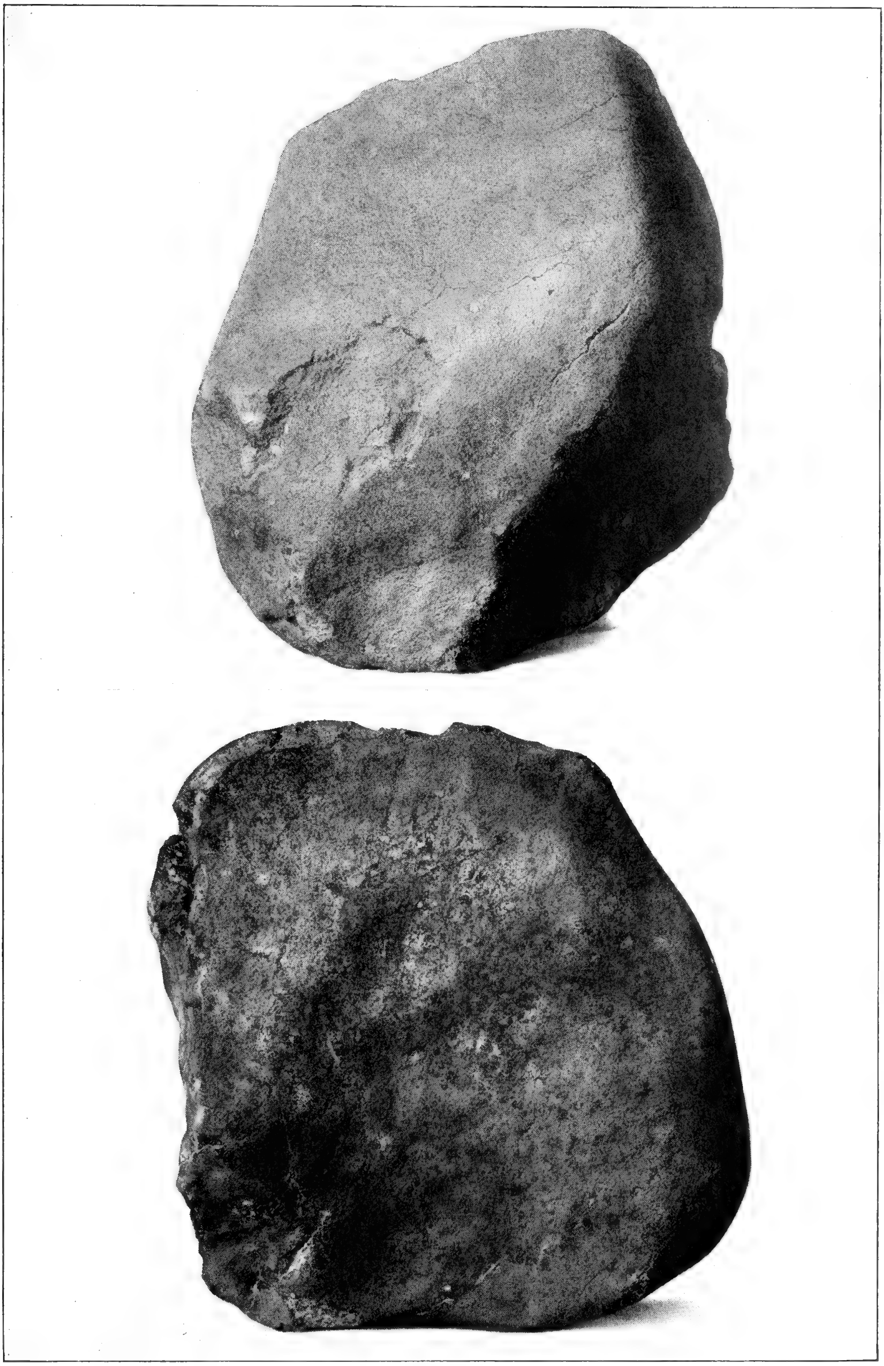


DIAGRAM OF TOWNSHIPS OF THE SOUTHERN PART OF SHERIDAN COUNTY, KANSAS, SHOWING PLACE OF FALL OF SALINE METEORITE AND DIRECTION OF MOVEMENT OF METEOR. SCALE 1 INCH = $4\frac{1}{3}$ MILES.



FRONT AND REAR VIEWS OF SALINE METEORITE. X $\frac{1}{4}$.

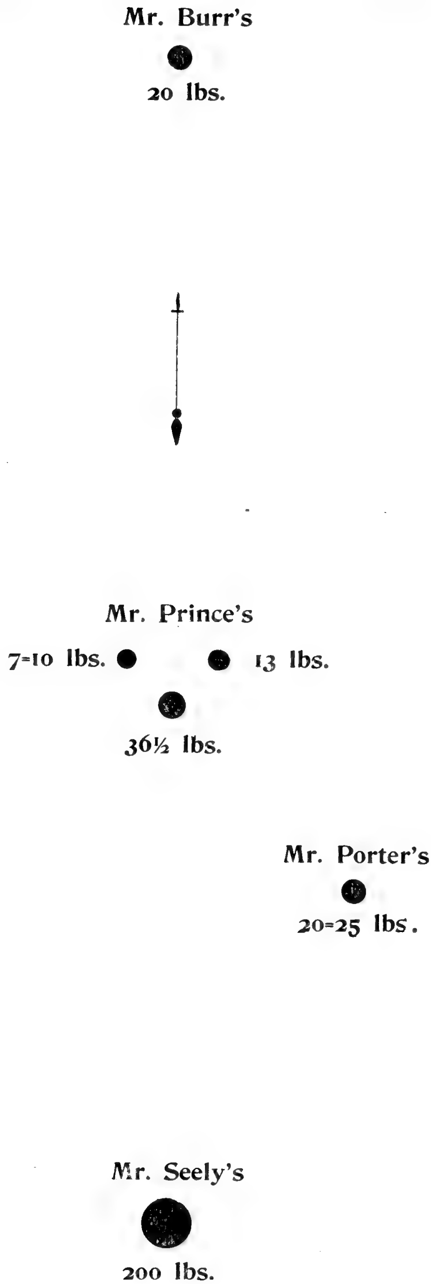
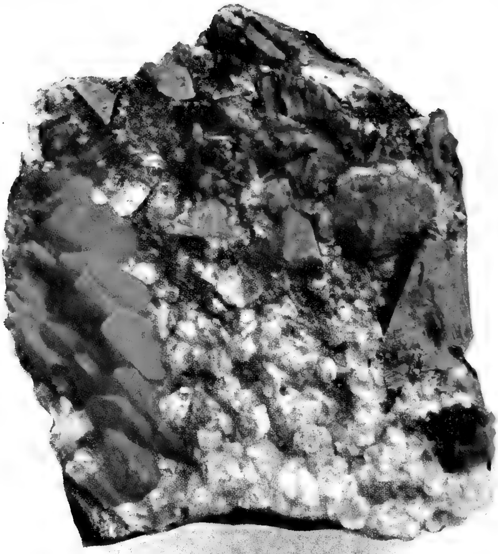


Diagram Showing Distribution of Individuals of Weston Meteorite. The Length of the Area Included is Nine Miles.



Orpiment, Mercur, Utah.

Realgar
Golden Gate Mine
Mercur, Utah.

Realgar
Mercur, Utah.

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NOTES ON VARIOUS MINERALS IN THE MUSEUM COLLECTION

BY OLIVER CUMMINGS FARRINGTON AND EDWIN WARD TILLOTSON, JR.

ANGLESITE

TINTIC DISTRICT, UTAH

PLATES XLV AND XLVI

An especially fine series of crystallized anglesite, received from Maynard Bixby, all from the Tintic District, Utah, and chiefly from Eureka, afforded material for a study of the crystal habits of the mineral. The specimens were the choicest of many that had been collected by Mr. Bixby, and are probably, therefore, the best representation of the anglesite of the locality that has yet been obtained.

The crystals occur almost wholly in cavities in galena, the cavities as a rule having a diameter of from 1 to 4 inches. The galena shows a coarse, granular structure as a rule. The crystals of anglesite occurring in these cavities are for the most part colorless, but some are white and several show a tinge of yellow, in some cases a deep canary yellow; others exhibit smoky or gray shades. As a rule the crystals are nearly transparent, some completely so, but others show cloudings which may be so abundant as to make the crystals practically opaque. As is usual with anglesite, the lustre is highly adamantine in some specimens, but in others more nearly vitreous. The crystals vary in size from minute, lining druses, to one having a length of 4.5 centimeters (1¾ inches). For the most part a length of about 8 millimeters may be considered descriptive of the size. The crystal planes as a rule are well developed and afford fairly good measurements with the reflecting goniometer. Not infrequently, however, the surfaces are more or less uneven so that only broken reflections are obtained. The planes of the different forms are as a rule uniform in lustre and character of surface, with the exception of the macropinacoid, *a* (100), which is nearly always characterized by being striated in the direction of the vertical axis. It can usually be recognized by the naked eye

by this peculiarity and thus the orientation of the crystal is much facilitated. These striations are probably the result of oscillation of the plane *a* (100) with prismatic planes, and in some crystals, as shown in Fig. 3, Pl. XLVI, this is obviously the case.

As is usual with anglesite, the crystals exhibit a variety of habits, no single habit predominating. The habits noted may be described as tabular, prismatic, and pyramidal. Of these perhaps the most striking and unusual to anglesite is the tabular one. It is produced by a pronounced development of the basal planes uniting with a short unit prism. Figs. 2 and 3, Pl. XLV, showing crystals taken from specimens having the Museum Numbers M 9579 and 7293, illustrate the habit. Crystals of this type may be simple or highly modified. In some the prism becomes longer in the direction of the vertical axis, as shown in Fig. 3, Pl. XLV. Crystals of this type are usually attached by one of the planes of the unit prism so that their orientation is not always obvious at a glance.

Prismatic habits are common and, as is usual with anglesite, the habit may be produced by elongation in the direction of either of the axes. Crystals elongated in the direction of the vertical axis are illustrated in Fig. 4, Pl. XLV (Mus. No. M 9590) and Fig. 1, Pl. XLVI (Mus. No. M 9586). Of these No. M 9590 is from the Bullion Beck mine. It exhibits the peculiarity of having the prism *m* (110) at one end of the crystal and the prism δ (230) at the other. As illustrated in the figures, the crystals of the vertically elongated prismatic habit may have pointed or blunt terminations. The blunt termination is produced by broad development of the basal plane and gives an especially characteristic form (Fig. 1, Pl. XLVI). Crystals elongated in the direction of the brachy-axis are illustrated by Fig. 2, Pl. XLVI (Mus. No. M 9587). Crystals of this type are inclined to stoutness. They are semi-transparent and have the planes well developed. The finest crystal of the whole collection exhibits this habit, the elongation in the direction of the brachy-axis being, however, less than shown in the figure of the type. This crystal has a length of 2 centimeters in the direction of the vertical axis and 1.5 centimeters in the direction of the macro-axis. It is perfectly transparent and colorless. Another superb crystal of this habit has a well-marked canary yellow color. It is about three-fourths the size of the one previously mentioned.

Fig. 3, Pl. XLVI (Mus. No. M 9582) shows a crystal form in which the elongation occurs in the direction of the macro-axis. Crystals of this type are as a rule small, having a maximum length of about 1.5

centimeters, and possess a yellow tinge. They may be described as having a wedge-shaped form, this being chiefly produced by the development of the prism M (410).

Another prismatic habit is characterized by a normally developed unit prism combined with extended basal and macropinacoids. Several pyramids also usually round the edge between the basal plane and prism. These crystals are as a rule transparent and colorless and rather small in size, their length in the direction of the vertical axis being about 4 millimeters, and in the direction of the macro-axis, about 7 millimeters. Fig. 1, Pl. XLV (Mus. No. M 9573) illustrates this habit.

The only remaining habit to be noted is a pyramidal one. Crystals of this habit are as a rule of simple development and are composed principally of the pyramid *y* (122) with minute basal planes and macro or brachydomes. One crystal of this type also shows small planes of the unit prism. These crystals have average lengths in the direction of the vertical axis of from 5 to 10 millimeters. On one specimen (Mus. No. M 9569) represented in Fig. 4, Pl. XLVI, the crystals have a milk-white color, while those of another specimen (Mus. No. M 9576) represented in Fig. 5, Pl. XVLI, are more nearly transparent and dark colored. The occurrence of the macrodome on one and brachydome on the other is also notable. One specimen (Mus. No. M 9677) exhibits a single large crystal possessing a pyramidal habit, but owing to the rounded nature of the planes the symbol could not be determined. The crystal is 4.5 centimeters in length, partially opaque, and of a dark yellow color. Another habit of occasional occurrence is produced by a combination of a pyramid and prism in about equal proportions. Crystals of this type (Mus. No. M 9581) are illustrated in Fig. 6, Pl. XLVI. They are not as a rule doubly terminated, but are so occasionally. Generally they are small, about .7 of a centimeter being an average length. These crystals are also as a rule transparent and colorless.

A total list of the forms observed on the Eureka anglesites is as follows:

a (100)	δ (230)	*r* (112)
b (010)	*n* (120)	*z* (111)
c (001)	*o* (011)	τ (221)
m (110)	*d* (102)	*p* (324)
M (410)	*l* (104)	*y* (122)
		μ (124)

BARITE

CARTERSVILLE, GEORGIA

FIGS. 1-3, PLATE XLVII

A fine suite of barite crystals from the above locality was presented to the Museum in the fall of 1902 by Prof. S. W. McCallie, the present State Geologist of Georgia. The specimens have the Museum Nos. M 7172–7235. While the occurrence of barite at the Cartersville locality has been described before, its crystallographic characters do not seem to have been given in detail. It seemed, therefore, desirable to make a crystallographic study of this suite.

The manner of occurrence of the barite has been fully described by Hayes* who states that it accompanies bodies of ocher occurring in the Cambrian quartzite of the region, the ocher being mined extensively for economic purposes. Numerous passages and cavities penetrating the quartzite and ocher are lined, Hayes states, in the case of the smaller cavities with a crust of small quartz crystals, while the larger ones frequently contain beautiful crystals of barite, which according to Hayes, "were probably deposited after the conditions favorable for the solution of silica and the deposition of ocher had passed." Hayes also says, "Groups of acicular crystals of this mineral several inches in length are not uncommon. It also occurs in white granular veins. The barite is called 'flowers of ocher' by the miners. It remains in the residual soil which covers the quartzite outcrops and affords the best means of tracing the ocher deposits. It is found at numerous points on the low quartzite ridge north and south of the Etowah river; and prospecting at these points has never failed to reveal more or less extensive deposits of ocher."

The crystals in possession of the Museum form, as a rule, interpenetrating groups or clusters, some of which are nearly a foot in length. The individuals of the group are often largely made up of aggregates having the macro-axis in common. These combine so as to produce a polysynthetic individual with serrated edges. The crystals are transparent to translucent except where the ocher enters into their substance in quantity, in which case it renders them opaque. The color of the transparent crystals is a delicate greenish-blue; but the crystals that are opaque partake to a greater or less degree of the yellowish-brown color of the ocher.

*Geological Relations of the Iron Ores in the Cartersville District, Georgia, Trans. Amer. Inst. Mining Engineers, 1900, Vol. XXX, p. 418.

The habit of the simple crystals is uniformly tabular with respect to *c* (100). They are usually also slightly lengthened in the direction of the macro-axis. The planes are bright and sharply outlined and give good signals with the reflecting goniometer. In length, in the direction of the brachy-axis, the individuals vary from 1 to 2.5 centimeters. Their average thickness is about 5 millimeters. They are rarely highly modified. They are usually made up chiefly of three pinacoids and the unit prism, pyramid and brachydome. Striations parallel with the edge *m a* usually characterize the prismatic zone except for planes of *m*, *a* and *b*, which are smooth and bright. Fig. 1, Pl. XLVII shows the usual type. The development of the prism is, however, not as a rule as well-defined as indicated in the figure, the zone from *a* to *m* being often considerably rounded and showing no well-marked planes. There may also occur a rounding of this sort between *m* and *b*. Such rounding is, in fact, quite characteristic. Some crystals are somewhat more highly modified than the above. These show as a rule several pyramids and an increased number of prisms. Figure 2, Plate XLVII (Mus. No. M 7197) illustrates such a crystal. This crystal was about 1 sq. cm, in area and 2 mm. thick.

Perhaps the most interesting type presented by these barites is that already mentioned in which numbers of smaller crystals combine to produce a crystal of different habit. The most common form of these is illustrated in Fig. 3, Pl. XLVII. Here small primary crystals, chiefly made up of the basal plane and unit prism, have grown together in parallel position to form a crystal of tabular habit which shows essentially the planes *c* (001), *a* (100), and *o* (011). Here, therefore, the crystallizing force controlled the arrangement and situation of the individual crystals as well as that of the molecules in the crystals themselves. The crystal here illustrated is not doubly terminated in the direction of the *a* axis, but in all other directions is fully developed. The size of these large polysynthetic crystals is from 3 to 6 centimeters in the direction of the *a* axis, and in the direction of the *c* axis about one-fourth of this. Groups of diverging crystals which have no apparent regularity, also occur among the specimens.

The total forms observed on the Cartersville barites and some of the measurements obtained are as follows:

c (001)	χ (130)	*f* (113)
a (100)	λ (210)	*q* (114)
m (110)	*o* (011)	*y* (122)
n (120)	*z* (111)	

					Observed	Calculated
$m \wedge m'''$	=	$(110) \wedge (1\bar{1}0)$	=	$78° 25'$	$78° 22'$
$\lambda \wedge \lambda'''$	=	$(210) \wedge (2\bar{1}0)$	=	$44° 27'$	$44° 21'$
$b \wedge n$	=	$(010) \wedge (120)$	=	$31° 23'$	$31° 31'$
$b \wedge \chi$	=	$(010) \wedge (130)$	=	$22° 17'$	$22° 14'$
$o \wedge o$	=	$(011) \wedge (01\bar{1})$	=	$74° 27'$	$74° 34'$
$c \wedge z$	=	$(001) \wedge (111)$	=	$64° 50'$	$64° 19'$
$c \wedge f$	=	$(001) \wedge (113)$	=	$34° 40'$	$34° 43'$
$c \wedge q$	=	$(001) \wedge (114)$	=	$27° 34'$	$27° 28'$
$c \wedge y$	=	$(001) \wedge (122)$	=	$57° 10'$	$57° 1'$
$o \wedge y$	=	$(011) \wedge (122)$	=	$26° 15'$	$26° 1'$

BERTRANDITE

ALBANY, MAINE

FIGS. 4–5, PLATE XLVII

In the summer of 1902, Mr. C. C. Spratt, at that time a resident of North Bridgton, Maine, submitted to one of the authors some hand specimens showing small, colorless crystals, which proved on examination of their blowpipe characters to be bertrandite. Mr. Spratt kindly indicated the locality from which the specimens were obtained and this was later visited by one of the authors. The locality is an area of coarse pegmatite in the northern part of the town of Albany, Maine. The pegmatite exhibits the usual coarse crystals of quartz, feldspar, tourmaline, mica, and beryl and has been worked to some extent to obtain the two latter minerals for economic purposes. The bertrandite was nowhere found to be abundant, but by close searching could occasionally be obtained. It occurs in single or grouped crystals implanted upon quartz or lining cavities one or two inches in diameter. In one of these cavities a considerably corroded piece of colorless beryl was found suggesting that the bertrandite may have been derived from alteration of the beryl. The crystals of bertrandite obtained (Mus. No. M 6969) are for the most part colorless to pale white and transparent to translucent. Some are covered with a rusty coating which readily dissolves in hydrochloric acid. The crystals all show a tabular habit produced by extensive development of the basal planes. In habit they thus resemble the crystals of Mt. Pisek and Mt. Antero rather than those described by Penfield * from Stoneham, although the latter locality is near Albany. The largest crystal of

* Am. Jour. Sci., 1889, 3, 37, p. 214.

the Albany material in the Museum is 10 mm. long, 10 mm. wide and 2 mm. thick. Some crystals seen must have been even larger than this but they were broken in excavating. The crystals in cavities are as a rule smaller than those attached to quartz, their average size being 3 x 3 x 1 mm. The attachment of all the crystals is always along an edge parallel with the vertical axis. They thus rarely show more than half the faces belonging to the prismatic zone. Their outline tends to be rectangular or hexagonal, according as the lateral pinacoids or the prisms predominate. The orientation adopted for the crystals for measurement was determined by the basal plane and by a pinacoidal cleavage normal to this which was regarded as that of the brachypinacoid, *b* (010). The distinctive characters of the base are its pearly luster and striations || to *a* (100). In addition to the cleavage || to *b* (010), a prismatic cleavage giving angles of nearly 60° was occasionally observed. The faces of the crystals on casual inspection appear bright and would seem to be well suited for measurement, but on closer examination their surfaces are found as is usual with bertrandite to be uneven and to give elongated reflections. This is especially true in the prismatic zone, where nearly all the measurements give variations between 2° and 3°. By taking the mean of these, however, values were obtained which served for identifying the faces. The crystals are not highly modified, only six forms being observed, as follows:

c (001)	*a* (100)	*f* (130)
b (010)	*m* (110)	**l* (203)

Of these *l* (203) is new to bertrandite, its determination being based on the measurement $c \wedge l = (001) \wedge (203) = 33° \ 56'$. The calculated angle for this form, using the axial ratios of Penfield* is 34° 59′ or using those of Urba† is 34° 48′. While the agreement of measured and calculated values for this form is not as close as could be desired it is all that can be expected when the imperfections of the planes are considered. The measurements upon which the determinations of the prisms were based are as follows, these being shown with the values calculated from both Penfield's and Urba's ratios:

		Observed	*Calculated* Penfield	*Calculated* Urba
$m \wedge m'''$	$= (110) \wedge (1\bar{1}0)$	= 58° 52′	59° 16′	59° 21′
$f \wedge f'$	$= (130) \wedge (\bar{1}30)$	= 61° 12′	60° 44′	60° 39′
Cleavage ∧ cleavage	= (110) ∧ (010)	= 60° 16′	60° 22′	60° 19′

* Am. Jour. Sci., 1889, 3, 37, p. 215.

† Zs. Zr. 1889, 15, p. 194.

There is little variation in the development of the crystals, the principal differences being in the development of the macropinacoid *a* (100). When this is extended, as shown in Fig. 4, Pl. XLVII, the crystals have a generally rectangular outline; when it is developed about equally with the prisms, the crystals have an apparently hexagonal outline if, as is usually the case, only half of the crystal is present. Again the unit prism *m* (110) may be wanting entirely. If so, the crystal is usually elongated in the direction of the macro-axis and attached by the brachypinacoid *b* (010) so that the appearance illustrated in Fig. 5, Pl. XLVII is obtained. This drawing is made with *b* (010) in front in order to show the characteristic appearance. The form *l* (203), as illustrated in the figures, occurs at only one end of the vertical axis. The absence of a corresponding plane indicates hemimorphism in the direction of the vertical axis such as was noted by Penfield.* The edge opposite to *l* (203) produced by the junction of *c* ($00\bar{1}$) and *a* (100) and that upon which a plane corresponding to *l* would normally appear if the crystal were holomorphic, is never sharp, but grades irregularly toward the center of the crystal by successive overlying lamellae, all of which have irregular edges. Such indications of lamellar structure suggest twinning similar to that noted by Penfield on crystals from Mt. Antero,† but study of cross-sections of the crystals in polarized light gives no evidence to support such a view. Extinction in polarized light occurs parallel to the pinacoidal cleavage of the crystals, thus affording additional proof of the orthorhombic crystallization of the mineral. On slight heating the crystals become strongly electric so that they pick up pieces of paper. Before the blowpipe they exfoliate slightly and when heated in the closed tube decrepitate. The other blowpipe characters observed were similar to those which have been mentioned by previous observers.

CALAMINE

LEADVILLE, COLORADO

Among specimens received by the Museum from the World's Columbian Exposition, a series of ores from the Maid of Erin mine, Leadville, Colorado, contained an ocherous substance thickly coated with long, slender crystals. These crystals proved on examination by means of a blow-pipe to be calamine. The occurrence seems not to have been hitherto described, although Pratt has given an

* Loc. cit.

† Loc. cit.

account of calamine,* of a habit quite similar to the above and also from a Maid of Erin mine. The occurrence described by Pratt is, however, in Clear Creek Co., Colorado, while the locality here represented is in Lake Co. As the crystals prove upon examination to exhibit a development somewhat different from that described by Pratt, there seems little doubt that they represent a separate occurrence. Inquiry by the writer of the company now operating the mine from which the Leadville calamine was stated to have come, elicited the information that some of the workmen thought that such crystals had been obtained in earlier operations at the mine but none was being found at the present time. The company also forwarded a specimen quite similar to the one above mentioned, with the information that it had been found at the El Paso mine adjoining.

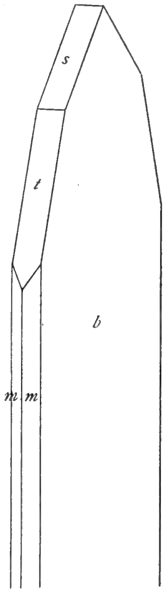

FIG. 1. Calamine.

Like the Clear Creek Co. calamine, the Leadville crystals are tabular with respect to *b* (010) and considerably striated in the prismatic zone. They are, however, differently terminated. Most commonly the termination is the unit macrodome *s* (101). Occasionally, however, the steeper dome *t* (301) is to be seen and the unit brachydome probably also occurs although this could not be verified. The usual appearance of the crystals is illustrated in the accompanying Fig. 1. Occasionally there is a larger development of the prism, giving a stouter form. The crystals tend to form groups which are partly radiated and partly joined by the brachy-pinacoid. No doubly terminated crystals were found, so that no opportunity was afforded for a study of the hemimorphic characters of this mineral. Gentle heating causes the crystals to become strongly electric. The character of the electricity developed by such heating was tested in the following manner: Numerous crystals were suspended by silk threads and after heating, glass rods electrified by silk or sealing wax excited by flannel were brought near. In every case the positively electrified substance, i. e., the glass, attracted the terminated end of the crystal and the negatively electrified, the broken end. The average length of the crystals is about 10 mm. They are transparent to translucent and colorless to white. The faces best suited for measurement are the macrodomes, an especially sharp

* Am. Jour. Sci., 1894, 3, 48, p. 213.

measurement of *t* (301) on *s* (101) having been secured on one crystal. The striations in the prismatic zone make measurements there unsatisfactory although results of sufficient accuracy for the identification of the planes were secured. The following are some of the measurements obtained:

				Measured	Calculated
$t \wedge s$	=	$(301) \wedge (101)$	=	29° 53′	29° 57′
$s \wedge s'$	=	$(101) \wedge (\bar{1}01)$	=	62° 54′	62° 46′
$m \wedge m'''$	=	$(110) \wedge (1\bar{1}0)$	=	75° 35′	76° 9′
$m \wedge b$	=	$(110) \wedge (010)$	=	52° 20′	51° 55′

CALCITE

JOPLIN DISTRICT, MISSOURI

PLATE XLVIII AND FIG. 2, PLATE XLIX

A number of crystallized specimens of calcite from the Joplin District, Missouri, received for the most part from Maynard Bixby, present features hitherto undescribed. Most of the specimens are twin crystals. The specimen bearing the Museum No. M 8695 and shown in Fig. 2, Pl. XLVIII, is from the Cuban mine, Joplin. The twinning plane is *e* $(01\bar{1}2)$ and the crystal shows its greatest elongation in the direction of this plane. The length in this direction is 11 cm. (4½ inches), while at right angles to this plane it is only about half as long (5 cm.). The form of the twin is roughly prismatic, the sides of the prism being planes of the unit rhombohedron *r* $(10\bar{1}1)$ and the scalenohedron 𝔅: $(51\bar{6}1)$.* At one end the crystal was attached, and here it shows only the cleavage rhombohedrons, but at the other end occur a re-entrant angle and a number of modifying forms. The latter forms are the rare scalenohedrons enumerated below. All are about equally developed. The substance of the twin is white and opaque in the interior and yellowish and nearly transparent on the exterior. The boundary between these two portions is rather distinctly marked, the thickness of the exterior portion being about 5 mm. The planes of the crystal have brilliant, flat surfaces as a rule, but the larger ones are more or less undulating both as to surfaces and edges. Measure-

*Goldschmidt's letter. One of the authors has elsewhere (Pub. Field Col. Mus. Geol. Ser. Vol. I., p. 239) given reasons for combining the use of Dana's and Goldschmidt's letters. The two kinds of letters can be distinguished by remembering that Goldschmidt's letters are followed by dots.

ments were made by contact. The forms determined and measurements obtained are as follows:

$r(10\bar{1}1)+R$	$\mathfrak{B}{:}(51\bar{6}1)+4R\frac{3}{2}$	$\Delta(23\bar{5}2)-\frac{1}{2}R5$
$\mu(54\bar{9}1)+R9$	$G{:}(72\bar{9}5)+R\frac{9}{5}$	
$J{:}(52\bar{7}3)+R\frac{7}{3}$	$z(12\bar{3}5)-\frac{1}{5}R3$	

			Observed	Calculated
$\Delta \wedge \Delta'$	=	$(23\bar{5}2) \wedge (\bar{2}5\bar{3}2)$ =	40°	42° 14′
$r \wedge \Delta$	=	$(1011) \wedge (23\bar{5}2)$ =	36°	35° 45′
$\mu \wedge \mu'$	=	$(54\bar{9}1) \wedge (\bar{5}9\bar{4}1)$ =	66°	66° 43′
$\mathfrak{B}{:} \wedge \mathfrak{B}{:}'''$	=	$(51\bar{6}1) \wedge (\bar{1}561)$ =	136°	133° 19′
$r \wedge \mathfrak{B}{:}$	=	$(10\bar{1}1) \wedge (51\bar{6}1)$ =	36°	35° 54′
$z \wedge z'$	=	$(12\bar{3}5) \wedge (\bar{1}3\bar{2}5)$ =	37°	35° 16
$G{:} \wedge G{:}^{v}$	=	$(72\bar{9}5) \wedge (9\bar{2}\bar{7}5)$ =	21°	20° 44′
$r'' \wedge G{:}$	=	$(0\bar{1}11) \wedge (\bar{7}9\bar{2}5)$ =	92°30′	92° 31′
$r \wedge \mu$	=	$(10\bar{1}1) \wedge (54\bar{9}1)$ =	44°	44° 11′
$r'' \wedge J{:}$	=	$(0\bar{1}11) \wedge (52\bar{7}3)$ =	98°	99° 14′

A calcite twin bearing the Museum No. M 8692 is shown in Fig. 1, Pl. XLVIII. This is from the Crystal Palace mine, Central City, Missouri. The twinning plane is *c* (0001). The dominant forms are the rare rhombohedron $\upsilon\cdot(05\bar{5}3)$ and *e* $(01\bar{1}2)$. These produce an approximately spheroidal twin, but only about half the spheroid is present in this specimen. The halving is due to the manner of growth from the attachment. The twin is complete in a polar direction, but incomplete equatorially. The length of the polar diameter is 5.5 cm. The substance of the twin is wine-yellow, and transparent. All of the planes, however, with the exception of those of the rhombohedron *e* $(01\bar{1}2)$, are coated with a thin, firmly adhering layer of iron oxide, chocolate brown in color. The planes of *e* are striated, as represented in the drawing, and as also represented there unite with those of $\upsilon\cdot$ by a curved edge. The common forms *v* and M modify the dominant forms. The twin is thus made up of three rhombohedrons, two of which are negative and one positive, and the scalenohedron *v*. Of the rhombohedrons, $\upsilon\cdot(05\bar{5}3)$ seems to have been first noted by Thürling * who, however, gave it no letter. Whitlock,† who observed it on calcite from West Paterson, N. J., gave it the letter here employed.

The measurements which were made on the specimen were by contact, but the planes were so well marked that there seems

* Neues Jb. Beil. Bd., 1886, 4, p. 380.
† Am. Jour. Sci., 1907, (4), 24, p. 427.

little doubt of their accuracy. The forms and measurements are as follows:

$e(01\bar{1}2)-\frac{1}{2}R$ $\quad v.\ (05\bar{5}3)-\frac{5}{3}R$ $\quad M(40\bar{4}1)+4R$ $\quad v(21\bar{3}1)+R3$

					Observed	*Calculated*
$e \wedge e'$	=	$(01\bar{1}2)$	$\wedge$	$(\bar{1}012)$	= 46°	45° 3′
$v. \wedge v.'$	=	$(05\bar{5}3)$	$\wedge$	$(\bar{5}053)$	= 95°	95° 26′
$M \wedge v.$	=	$(40\bar{4}1)$	$\wedge$	$(05\bar{5}3)$	= 57°	57° 12′
$v \wedge v'$	=	$(21\bar{3}1)$	$\wedge$	$(\bar{2}3\bar{1}1)$	= 73°	75° 22′
$M \wedge M$ of twin	=	$(40\bar{4}1)$	$\wedge$	$(40\bar{4}1)$	= 29° 10′	28° 26′

The specimen bearing Museum No. M.8696, and shown in Fig. 2, Pl. XLIX, exhibits a habit resembling that described by Sterrett* as presented by twins from the Maybell mine, North Empire, Kansas. The Museum specimen is from the Blackberry mine, Joplin. It lacks the amethystine color characteristic of the Maybell mine twins, being colorless and transparent except for small internal reflections and inclusions. Neither is the Blackberry mine twin characterized by large size as are the majority of the Maybell mine twins. The greatest length of the specimen here described is along the twinning plane in the direction of the edge *e f*, and is 8 cm. Normal to this in the same plane the length is 4 cm., and normal to the plane the length is 2 cm.

Like the Maybell mine twins this twin exhibits a prismatic form produced by prominence of the planes *e* and *t*. One end of the prism terminates in a re-entrant angle with modifying planes, while the other end was attached and exhibits the cleavage rhombohedrons of the two individuals, forming a salient angle. Aside from this occurrence of the unit rhombohedron it does not appear on the twin although on the Maybell mine twins it is prominent. Two scalenohedrons occur on the re-entrant angle of the twin, neither of which is represented in the Maybell mine twins. These are *E* $(41\bar{5}6)$ and a form new to calcite, ν:$(11.4.\bar{15}.3)$.† Two rhombohedrons, which are the common forms, *f* and M, round the edge between *e* and E. The rhombohedron *e* as will be noted by the figure, is the dominant form of the twin and is also the twinning plane. The common scalenohedron *v* which does not occur at all on the Maybell mine twins, occurs in this twin along the edge on which the individuals meet.

The planes of the crystal are for the most part brilliant and have sharp edges. The scalenohedron *E* however, is striated. Owing to

* Am. Jour. Sci., 1904. 41, 8, p. 73-76.

† The authors are indebted to Dr. Palache for designating this letter.

the size of the crystal, measurements were for the most part made by contact rather than by reflection.

The following is a list of forms and angles found, the new form being marked by an asterisk:

$e\ (01\bar{1}2)+\frac{1}{2}R$	$t\ (21\bar{3}4)+\frac{1}{4}R\ 3$	$E(41\bar{5}6)+\frac{1}{2}\ R\frac{5}{3}$
$f\ (02\bar{2}1)+2R$	$v\ (21\bar{3}1)+R\ 3$	$*\nu{:}(11.\ 4.\ \bar{15}.\ 3)+\frac{7}{3}\ R\ \frac{15}{7}$
$M\ (40\bar{4}1)+4R$		

			Observed	Calculated
Cleavage $\wedge\ e'$	=	$(10\bar{1}1)\ \wedge\ (\bar{1}012)$	= 71°	70° 51′
$e\ \wedge\ f$	=	$(01\bar{1}2)\ \wedge\ (02\bar{2}1)$	= 37° 30′	36° 52′
$e\ \wedge$ M	=	$(01\bar{1}2)\ \wedge\ (04\bar{4}1)$	= 77° 30′	77° 58′
$e\ \wedge\ t$	=	$(01\bar{1}2)\ \wedge\ (21\bar{3}4)$	= 21°	20° 58′
$e\ \wedge\ v$	=	$(01\bar{1}2)\ \wedge\ (21\bar{3}1)$	= 67°	66° 24′
$E\ \wedge\ E^{v}$	=	$(41\bar{5}6)\ \wedge\ (5\bar{1}\bar{4}6)$	= 15°	13° 4′
$E\ \wedge$ M	=	$(41\bar{5}6)\ \wedge\ (40\bar{4}1)$	= 38° 30′	39° 44′
$e'\ \wedge\ E$	=	$(\bar{1}012)\ \wedge\ (41\bar{5}6)$	= 118°	117° 6′
M $\wedge\ \nu{:}$	=	$(40\bar{4}1)\ \wedge\ (11.\ 4.\ \bar{15}.\ 3)$	= 15°	14° 35′
$e\ \wedge\ \nu{:}$	=	$(01\bar{1}2)\ \wedge\ (11.\ 4.\ \bar{15}.\ 3)$	= 77°	77° 21′
$t\ \wedge\ \nu{:}$	=	$(21\bar{3}4)\ \wedge\ (11.\ 4.\ \bar{15}.\ 3)$	= 72° 30′	72° 52′
$\nu{:}\wedge\nu{:}^{v}$	=	$(11.\ 4.\ \bar{15}.\ 3)\ \wedge\ (15.\ \bar{4}.\ \bar{11}.\ 3)$	= 30°	29° 5′

A number of groups of calcite crystals from the Joplin District, exhibited by a private collector, Mr. John C. Moore, at the Louisiana Purchase Exposition, were of especial interest on account of the large size of the crystals and the perfection of their planes. A number of these were obtained by the Museum (Mus. Nos. M 7874-7884). Examination of the crystals with the contact goniometer shows them to be made up of common forms, such as are already known to charac-

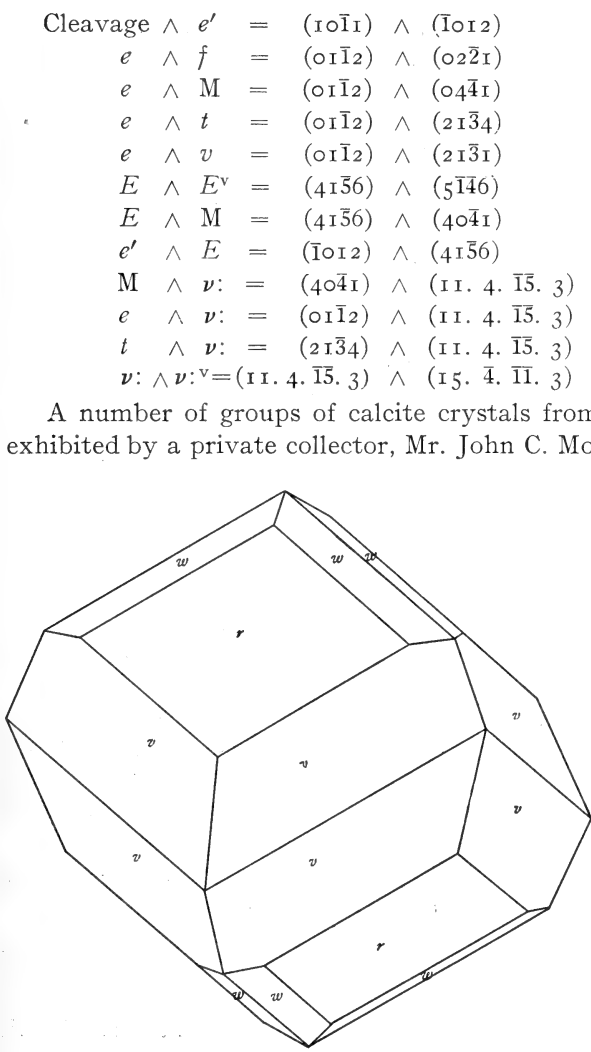

FIG. 2. Calcite.

terize the Joplin calcites, as described by one of the authors.* The average development of the forms is shown in the accompanying figure, Fig. 2. The planes of the different forms show readily recognizable peculiarities. Thus the planes of *v* $(21\bar{3}1)$ usually have brilliant, more or less undulating surfaces, those of *r* $(10\bar{1}1)$ are roughened like ground glass, and those of *w* $(31\bar{4}5)$ are smooth. The substance of the crystals is semi-transparent and amethystine in color. Needles and flakes of marcasite are included in large numbers through the substance. Fragments of the calcite phosphoresce with a warm yellow light when moderately heated, although Headden† found only the yellow Joplin calcite phosphorescent. The largest crystals measure a foot in length and weigh 20-30 lbs.

CALCITE

BELLEVUE, OHIO

FIG. 1, PLATE XLIX

A crystal of calcite (Mus. No. M 10372) kindly presented to the Museum by Mr. S. A. Kurtz, Principal of the Bellevue High School, shows some unusual features. The crystal is of the "dog-tooth" form and would appear on casual glance to be a polar half of a scalenohedron. It is 2.5 cm. in length and composed of colorless, transparent calcite. Mr. Kurtz states that such crystals occur at a depth of about twenty feet from the surface in a hard, blue layer of the Niagara limestone at Bellevue. An examination of the crystal with the reflecting goniometer shows that its fundamental forms are not scalenohedrons but pyramids of the second order. The dominant one of these is γ $(8.8.\overline{16}.3)$. This, it is of interest to note, was found by Penfield and Ford to be a dominant form on silicious calcite from the Bad Lands, Nebraska,‡ and Union Springs, New York.§ Rogers also found it a dominant form on calcite from Shullsburg, Wisconsin.|| The next pyramid of the Bellevue specimen cuts the vertical axis at one half the height of γ, its symbol being α $(44\bar{8}3)$. Above this occurs the pyramid π $(11\bar{2}3)$ cutting the vertical axis at one fourth the height of α. The pyramids are thus in Dana's symbols, $\frac{16}{3}$-2, $\frac{8}{3}$-2 and $\frac{2}{3}$-2.

* Farrington, Pub. Field Col. Mus., 1900, Geol. Ser. Vol. I, pp. 232-241.

† Am. Jour. Sci., 1906, 4, 21, p. 301.

‡ Am. Jour. Sci., 1900, 4, 9, p. 353.

§ Am. Jour. Sci., 1900, 4, 10, p. 237. The Union Springs occurrence was further studied by Whitlock (Bull. 98, New York State Museum) and the conclusion reached that the pyramidal habit was produced by crystallization from a highly siliceous solution.

|| Am. Jour. Sci., 1901, 4, 12, p. 42.

Combined with the pyramids are two scalenohedrons, one of which has the symbol 20. 11. $\overline{31}$. 11 ($+\frac{9}{11}$ R $\frac{31}{11}$) and the other occurs between this form and a. Although the latter is a well-defined plane no satisfactory reflections could be obtained from it for determining its symbol. Inasmuch, however, as its zonal relations are plainly shown on the crystal, it is represented in the drawing, Fig. 1, Pl. XLIX.

The form 20. 11. $\overline{31}$. 11 is new to calcite, and through the kindly advice of Dr. Charles Palache, the letter μ: was adopted for it. The form is so close to the common scalenohedron v (21$\bar{3}$1) that it would seem probable that the latter symbol was the correct one, but the measurements obtained allow no other conclusion than the symbol above chosen.

The following are some of the measurements obtained:

						Observed	*Calculated*
$a \wedge a'$	=	(44$\bar{8}$3)	$\wedge$	($\bar{4}$8$\bar{4}$3)	=	54° 27′	54° 30′
$a \wedge a^{v}$	=	(44$\bar{8}$3)	$\wedge$	(8$\bar{4}\bar{4}$3)	=	54° 40′	54° 30′
$\gamma \wedge \gamma'$	=	(8. 8. $\overline{16}$. 3)	$\wedge$	($\bar{8}$. 16. $\bar{8}$. 3)	=	58° 28′	58° 28′
$\gamma \wedge \gamma^{v}$	=	(8. 8. $\overline{16}$. 3)	$\wedge$	(16. $\bar{8}$. $\bar{8}$. 3)	=	58° 24′	58° 28′
$\gamma \wedge r$	=	(8. 8. $\overline{16}$. 3)	$\wedge$	(01$\bar{1}\bar{1}$)	=	63° 40′	63° 24′
$a \wedge \pi$	=	(44$\bar{8}$3)	$\wedge$	(11$\bar{2}$3)	=	36° 31′	36° 38′
$\pi \wedge \pi'''$	=	(11$\bar{2}$3)	$\wedge$	($\bar{1}\bar{1}$23)	=	59° 7′	59° 20′
$a \wedge r$	=	(44$\bar{8}$3)	$\wedge$	(10$\bar{1}$1)	=	32° 41′	32° 32′
$a^{v} \wedge r$	=	(8$\bar{4}\bar{4}$3)	$\wedge$	(10$\bar{1}$1)	=	32° 24′	32° 32′
$\mu{:} \wedge \mu{:}'$		(20. 11. $\overline{31}$. 11)	$\wedge$	($\overline{20}$. 31. $\overline{11}$. 11)	=	72° 44′	72° 9′
$\mu{:} \wedge \mu{:}^{v}$		(20. 11. $\overline{31}$. 11)	$\wedge$	(31. $\overline{11}$. $\overline{20}$. 11)	=	37° 27′	37° 47′

EPSOMITE

WILCOX STATION, WYOMING

Crystals of epsomite from the above locality were described by one of the authors in a previous publication.* It may be here noted that the figure there given should be turned at right angles to its position in the text in order to be correctly placed. Some time afterwards the late Prof. W. C. Knight, to whom the acquisition of the first crystals was due, kindly furnished about a dozen additional individuals which were somewhat more modified than those first described.

The habit of these crystals is stout, prismatic. The largest crystal was 31 mm. (1 ¼ in.) long in the direction of the vertical axis and

* Pub. Field Col. Mus., Geol. Ser., Vol. I, p. 228.

23 mm. (7/8 in.) long in the direction of the macro-axis. All the crystals are bounded by the planes *m* (110), *b* (010), *z* (111), and *z'* ($\bar{1}$11), although occasionally one of the sphenoids is absent. Some of the measurements taken with the reflecting goniometer on which these determinations were based are as follows:

			Observed	*Calculated*
$b \wedge m$	= (010) $\wedge$ (110)	=	45° 35′	46° 17′
$m \wedge m'''$	= (110) $\wedge$ (1$\bar{1}$0)	=	89° 20′	89° 26′
$z \wedge z'$	= (111) $\wedge$ ($\bar{1}$11)	=	53° 12′	53° 12′
$z \wedge z'''$	= (111) $\wedge$ (1$\bar{1}$1)	=	52° 38′	52° 38′

Recognition of the clinopinacoid *b* (010) is made easy by the prominent cleavage in that direction. In the development of the crystals the prism *m* (110), and one of the sphenoids *z* (111) are most prominent, although the clinopinacoid has in some of the crystals a width half as great as the prismatic faces. Occasionally, too, both of the sphenoids are found to be equally developed. An average development of the faces is shown in the accompanying figure (Fig. 3.)

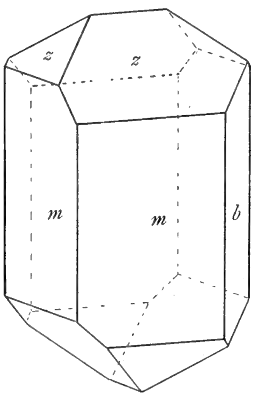

FIG. 3. Epsomite.

The crystals are simple individuals with the exception of two, each of which contains another individual implanted upon it, but not in any definite crystallographic direction. The crystals are all doubly terminated, but the planes are frequently imperfect and cavities are numerous. When first received the crystals were colorless and transparent, but in the Museum laboratory they have deliquesced.

LEADHILLITE

SHULTZ, ARIZONA

FIG. 1, PLATE L

A specimen of leadhillite from Shultz, Arizona, obtained from Maynard Bixby (Mus. No. M 9604), in the form of a single, large, cuboidal crystal with fragments of other leadhillite crystals attached, seems sufficiently unlike other occurrences of the mineral to warrant description. The sides of the apparent cube of this specimen have a length of 2½ centimeters. One of its surfaces is yellow-

ish-green, translucent and of resinous luster, but the remaining surfaces are coated with a white, opaque mineral evidently derived from alteration of the underlying substance. This coating is about 1 millimeter in thickness. The blowpipe characters of the principal mineral agree with those of leadhillite, and those of the coating mineral with cerussite. Alteration of leadhillite to cerussite was also observed by Penfield on crystals from this locality.* While the large crystal under consideration had an apparently cubical form, measurements of the angles with the reflecting goniometer, secured by attaching cover glasses to the planes, gave 87° 5′, 87° 30′ and 87° 48′. These results suggested the presence of a rhombohedron, especially as an apparently rhombohedral form of leadhillite, known as susannite, has been observed. Moreover, a well-marked cleavage truncating the solid angle in a manner corresponding to the basal cleavage of the rhombohedron occurs on the crystal. The angles of this cleavage upon the planes of the crystal are as follows: 51° 20′, 51° 57′, 52° 45′. These angles closely resemble those given for the rhombohedron of susannite by Dana,† his value for $c \wedge r$ being 128° 3′ and for $r \wedge r'$, 94°. It is thus apparent that the interfacial angles of the crystal would admit of its interpretation as a rhombohedron. On examining the cleavage plates with the polarizing microscope, however, well-marked biaxial characters appear. Interference figures perpendicular to the acute bisectrix are exhibited, with dispersion $\rho < v$ and a negative optical character. It is thus obvious that the crystal should be interpreted as monoclinic and must therefore probably be regarded as made up of a negative pyramid and an orthodome. The pyramid and dome most nearly corresponding with the angles given above are *t* (112) and *f* ($\bar{1}01$), the measured and calculated angles for these forms comparing as follows:

				Observed	Calculated
c (cleavage) $\wedge f$	=	(001) $\wedge$ ($\bar{1}01$)	=	51° 57′	51° 51′
c " $\wedge t$	=	(001) $\wedge$ (112)	=	52° 45′	51° 51′
$t \wedge t'$	=	(112) $\wedge$ ($1\bar{1}2$)	=	87° 5′	85° 6′

Fig. 1, Pl. L, shows the form thus produced. The habit seems not to have been hitherto observed in leadhillite except in so far as it may resemble the rhombohedral habit of susannite. The specific gravity of the mineral was found to be 6.42.

* Dana, System of Mineralogy, 1892, p. 922.
† Syst. Min., 1854, p. 373.

LINARITE

EUREKA, UTAH

FIGS. 2 AND 3. PLATE L

Several specimens of linarite from Eureka, Utah, were obtained from Maynard Bixby. Of these one specimen, Mus. No. M 9616, was especially remarkable for its size and perfection. The linarite occurs in this specimen as a single crystal attached to a siliceous matrix. On casual inspection the crystal has the appearance of a nearly square prism terminated by two dome planes. Measurement, however, shows that the crystal is, as is usual with linarite, elongated in the direction of the ortho-axis, the two apparent domes being the unit prism. The length of the crystal in the direction of the ortho-axis is 12 millimeters, and its width 6 millimeters. A re-entrant angle suggested that the crystal was probably twinned upon the basal plane, but as it was deemed undesirable to remove the crystal from its matrix, no careful study of this feature could be made. The color of the crystal is the deep azure-blue characteristic of linarite, and is so deep as to make the crystal as a whole practically opaque. On another specimen, Mus. No. M 9617, several smaller crystals occurred which permitted removal for measurement with the reflecting goniometer. The habit and attachment of some of these were the same as those of the large crystal, while others showed a more nearly tabular habit. The crystal selected for goniometric measurement exhibted the same habit as the large crystal and was 6 millimeters long by 3 millimeters wide. Its orientation was determined by well-marked cleavage parallel to the orthopinacoid. On this crystal in the zone of orthodomes two forms new to linarite were determined. These were δ (10.0.9) and ϕ ($\bar{9}$.0.10). Of these ϕ,($\bar{9}$.0.10) was the better developed. The occurrence of the domes and base nearly at right angles to *a* (100) gives the crystal a characteristically hexagonal appearance when viewed in the direction of the ortho-axis. In the pyramidal zone a new form *f* ($\bar{5}23$) was observed. Its determination was based on its occurrence in the zone *mgr* and the angle $f \wedge m' = (\bar{5}23) \wedge (\bar{1}10) = 52° 45'$. It will be noted that this pyramid occurs in the same zone with the unit dome *s* ($\bar{1}01$), and if this dome had been present in the crystal, as is frequently the case with linarite, a measurement would have been obtained of it in that zone. As a matter of fact, however, the dome which actually occurs was outside the zone *mgr*. This affords additional proof of the correctness of its

determination as ϕ ($\bar{9}$.o.10), although its position, so near that of the unit dome common to linarite, would suggest the possibility of its being confused with the latter. It may also be noted that the measurement from *a* (100) $\wedge$ *c* (001), is nearly the same as from *a* (100) $\wedge$ ϕ ($\bar{9}$.o.10). This would suggest twinning on the orthopinacoid, but on careful study of the crystal no evidence of twinning could be observed. The interpretation given above seems, therefore, to be the most reasonable one. The pyramid *f* ($\bar{5}$23) exhibits somewhat rounded faces; the dome *u* ($\bar{2}$01) is also characterized by somewhat undulating surfaces. No special characters were noted regarding the other planes. The appearance of the crystal as a whole is shown in Fig. 2, Pl. L. In Fig. 3, Pl. L a projection of these forms upon the clinopinacoid is shown. This exhibits to good advantage the characteristic zones of the crystal and its nearly square appearance when seen in the direction of the ortho-axis. The following is a list of the forms observed, together with some of the measured and calculated angles. The new forms are marked with an asterisk.

c (001)	**ϕ* ($\bar{9}$. o. 10)
a (100)	*x* ($\bar{3}$02)
m (110)	*u* ($\bar{2}$01)
r (011)	*g* ($\bar{2}$11)
**δ* (10. o. 9)	**f* ($\bar{5}$23)

				Observed	Calculated
$c \wedge x$	=	(001) $\wedge$ ($\bar{3}$02)	=	39° 59′	40° 3½′
$c \wedge u$	=	(001) $\wedge$ ($\bar{2}$01)	=	50° 14′	50° 6′
$c \wedge a$	=	(001) $\wedge$ (100)	=	77° 27′	77° 22′ 40″
$c \wedge \delta$	=	(001) $\wedge$ (10. o. 9)	=	24° 32′	25° 8′
$c \wedge \phi$	=	(001) $\wedge$ ($\bar{9}$. o. 10)	=	25° 15′	25° 23′
$r \wedge m$	=	(011) $\wedge$ (110)	=	50° 48′	51° 9′
$r \wedge a$	=	(011) $\wedge$ (100)	=	80° 28′	80° 13′
$g \wedge m'$	=	($\bar{2}$11) $\wedge$ ($\bar{1}$10)	=	42° 50′	42° 53′
$g \wedge a'$	=	($\bar{2}$11) $\wedge$ ($\bar{1}$00)	=	59° 11′	59° 27′
$f \wedge m'$	=	($\bar{5}$23) $\wedge$ ($\bar{1}$10)	=	52° 45′	52° 40′

MIMETITE

EUREKA, UTAH

FIGS. 4 AND 5, PLATE L

On several specimens from Eureka, Utah, obtained from Maynard Bixby, mimetite occurs in acicular form. In one of these specimens (Mus. No. M 8384), the crystals are in the form of minute white needles occurring in great abundance coating pyramidal crystals of anglesite. On another specimen (Mus. No. M 8385), the crystals are larger, reaching a length of 1 cm. with a thickness of .75 mm. These crystals are transparent and colorless. Many of them show a termination in which it is possible to recognize definite crystal planes, and examination with the reflecting goniometer permits identification of the unit prism *m* ($10\bar{1}0$), the unit pyramid *x* ($10\bar{1}1$) and the basal plane *c* (0001). Fig. 4, Pl. L, shows the characteristic development. In another specimen (Mus. No. M 9383), the mimetite exhibits the same habit, but the crystals are somewhat shorter and have a wine-yellow color. These crystals have an average diameter of .6 mm. and reach a length of 5 mm. The forms of which they are composed are similar to those previously mentioned, but the basal plane is more extensively developed as shown in Fig. 5, Pl. L. No doubly terminated crystals were found. Neither the colorless nor the yellow crystals exhibit noticeable absorption or pleochroism in polarized light in the direction of the vertical axis. On heating, the yellow crystals change to a smoky color.

OCTAHEDRITE

JEQUITINHONHA RIVER, BRAZIL

FIGS. 2-4, PLATE LI

Several crystals of octahedrite were presented to one of the authors by Olaf E. Ray, Esq., an official of the Chicago Brazilian Diamond Company. These crystals were obtained from washings of the diamond-bearing sand of the Jequitinhonha River, near Diamantina, Brazil. The crystals have the typical pyramidal character of octahedrite and range from 5 to 8 mm. in length. Their color is the typical brownish-black of the mineral showing greenish-yellow by transmitted light. Aside from striations the planes are splendent. The edges are somewhat rounded from stream rolling, but otherwise the crystals are well developed and give excellent signals with the

reflecting goniometer. Probably the most remarkable feature exhibited by the crystals is their apparently hemimorphic development. This development is shown in Figs. 3 and 4, Pl. LI. Thus the crystal shown in Fig. 3, Pl. LI, exhibits at one end a small basal plane with several modifying pyramids, while at the opposite end the basal plane alone occurs. Again, the crystal shown in Fig. 4, Pl. LI, shows one end considerably modified by pyramids, while the other possesses no modifying planes whatever. Such crystals might be expected to show pyro-electricity but careful tests for this property made with the kindly assistance of Prof. R. A. Millikan, of the University of Chicago, gave no indications of its presence. The apparent hemimorphism is perhaps therefore to be regarded as due to distortion only. Other interesting illustrations of distortion or merohedrism are shown by the crystals. Thus on the crystal shown in Fig. 3, Pl. LI, but a single plane of the pyramid v (117) occurs, while the other forms are present in normal number. The crystal shown in Fig. 4, Pl. LI, exhibits two planes of the pyramid v (117) and two planes of the pyramid r (115). In addition occur two planes only of the ditetragonal pyramid s_1 (5.1.19). On the crystal shown in Fig. 2, Pl. LI, a single plane of the pyramid of the second order G (104) occurs and a pyramid new to octahedrite, M (338) is present as two planes, while the development of the other pyramids is normal in character. No differentiation of the planes in luster or etching figures can be noted except that the pyramid of the second order G (104) shows numerous pittings. In addition the dominant pyramid p (111) is always characterized by striations parallel to the base. The total forms observed with angles follow, the one marked with an asterisk being new. The letter G has been given to the form 104, this having been listed by Hintze* but not lettered:

c (001)	r (115)	s_1 (5. 1. 19)
G (104)	v (117)	
p (111)	*M (338)	

				Observed	Calculated
$p \wedge p''$	=	(111) $\wedge$ ($\bar{1}\bar{1}1$)	=	136° 32′	136° 36′
$r \wedge r''$	=	(115) $\wedge$ ($\bar{1}\bar{1}5$)	=	53° 14′	53° 22′
$v \wedge v''$	=	(117) $\wedge$ ($\bar{1}\bar{1}7$)	=	39° 44′	39° 30′
$c \wedge$ G	=	(001) $\wedge$ (104)	=	23° 48′	23° 58′
$c \wedge$ M	=	(001) $\wedge$ (338)	=	43° 51′	43° 18′
$s_1 \wedge s_1'$	=	(5. 1. 19) $\wedge$ (1. 5. 19)	=	27° 33′	27° 38′
$p \wedge s_1$	=	(111) $\wedge$ (5. 1. 19)	=	48° 5′	48° 12′
$r \wedge s_1$	=	(115) $\wedge$ (5. 1. 19)	=	14° 46′	14° 41′
$v''' \wedge s_1$	=	($1\bar{1}7$) $\wedge$ (5. 1. 19)	=	21° 28′	21° 32′

* Handbuch der Mineralogie, 1906, Bd. I, p. 1563.

OLIVENITE

TINTIC DISTRICT, UTAH

PLATE LII

Crystals of olivenite from this locality have been previously described by Washington,* but a large suite of specimens received from Maynard Bixby affords some new characters which seem worthy of description. The olivenite in these specimens occurs both as well-defined crystals and in the fibrous form known as wood-copper. For the most part the crystals present the dark olive-green color characteristic of olivenite, although there are some variations from this, as will be noted. None of the crystals is highly modified, nor are they of large size. For the most part they exhibit a prismatic habit and occur encrusting cavities in a cupriferous gangue. The largest crystals noted (Mus. No. M 9414) are represented by Fig. 1, Pl. LII. These crystals are scattered in radiated fashion over a siliceous matrix and reach in some cases a length of 1 cm. They are usually attached by the macropinacoid *a* (100). As shown in the figure, they are simple in form, being made up of the unit prism *m* (110), the macropinacoid *a* (100) and the brachydome *d* (025). This dome is a form new to olivenite. Its determination was based on a good measurement of $d \wedge d' = 32° 45'$. A somewhat similar habit is exhibited by the crystals shown in Fig. 2, Pl. LII (Mus. No. M 9400), except that the basal plane occurs here and the macropinacoid is lacking. The dome and base are characterized by striations || to *a* (100). These crystals are of dark, nearly black, color, about 1 mm. in length and occur thickly encrusting a somewhat porous gangue. Another simple habit consists only of the unit prism and basal plane, producing a tabular form. This is exhibited in Fig. 3, Pl. LII (Mus. No. M 9413). These crystals occur lining a cavity about one inch in diameter. Sheaf-like crystals of azurite of a tabular habit are implanted upon the olivenite. The olivenite crystals are of a light olive-green color, with dull planes, and are usually attached by the basal plane. The average length of these crystals, measured in the direction of the macro-axis is 5 mm. A rather unusual habit for olivenite is that represented in Fig. 4, Pl. LII (Mus. No. M 9421). These crystals are elongated in the direction of the brachy-axis. The extension seems to be rather the result of growth of a number of

*Am. Jour. Sci., 1888, 3, 35, p. 298.

crystals in a parallel direction than the development of a single crystal. Nevertheless many of the planes give reflections like those of a single plane. The color of these crystals is a dark olive-green and they usually exhibit a radiated arrangement in their attachment. The individual crystals are attached by the end of the brachy-axis, their length averaging about 5 mm. The planes are as a whole brilliant and give fair reflections. Fig. 5, Pl. LII, represents a habit tabular with respect to *a* (100). This habit is exhibited by the crystals of a single specimen, Mus. No. M 9403. These crystals are very small, their greatest length being .5 mm. and thickness .1 mm. They are also peculiar in being nearly transparent and having a pale olive-green color rather than the deep green to black usually characteristic of the mineral. The cavity in which the crystals occur is lined with chrysocolla, and upon this the olivenite is implanted. The above specimens are all from Eureka, Utah. A single specimen, Mus. No. M 9419, from Mammoth, Utah, exhibits crystals differing somewhat in habit from any of the above. This habit is shown in Fig. 6, Pl. LI, and is characterized by prominent development of the basal planes, and elongation in the direction of the macro-axis, producing a tabular form. A brachydome not previously noted on olivenite also occurs on these crystals. This lies between the base *c* (001) and the unit dome *e* (011) and its determination is based upon its occurrence in the zone noted and the measurement $e \wedge s = 7° 50'$. Occurring with crystals of this habit are others of the habit shown in Fig. 2, Pl. LII. All the crystals on this specimen, Mus. No. M 9419, are greenish-black in color, opaque, and have brilliant planes. They occur encrusting cavities in massive malachite.

In the measurement of the crystals as a whole it was found that the angles observed did not agree with those obtained from the axial ratios of Washington as fully as could be desired. This discrepancy was especially noticeable in the measurement of the prism $m \wedge m'''$. A large number of measurements of this angle gave a value closely approximating 87° 28′, which differs nearly a degree from that obtained by Washington, his value being 86° 26′. Further, the measurement obtained for $e \wedge e'$, approximated in several good measurements closely to the value 69° 18′. These values agree more closely with the measurements of Phillips * than with those of Washington. The excellence of the measurements on the Eureka crystals seemed to warrant the calculation of axial ratios from them, and these

* Mineralogy, 1823, p. 319

were accordingly obtained as follows, the ratios of Washington and Phillips being given for comparison:

$a : b : c = 0.95873 : 1 : 0.69114$, Farrington and Tillotson.
$a : b : c = 0.9573 : 1 : 0.6894$, Phillips.
$a : b : c = 0.9396 : 1 : 0.6726$, Washington.

The total forms observed with the measured and calculated angles are as follows, new forms and fundamental measurements being marked with an asterisk:

a	(100)	v	(101)
b	(010)	e	(011)
c	(001)	*s	(034)
m	(110)	*d	(025)

			Observed	Calculated
$m \wedge m'''$	=	$(110) \wedge (1\bar{1}0)$	=	*87° 28′	
$e \wedge e'$	=	$(011) \wedge (0\bar{1}1)$	=	*69° 18′	
$a \wedge v$	=	$(100) \wedge (101)$	=	53° 59′	54° 9′
$e \wedge s$	=	$(011) \wedge (034)$	=	7° 50′	7° 15′
$d \wedge d'$	=	$(025) \wedge (0\bar{2}5)$	=	32° 45′	32° 20′

No marked pleochroism of any of the crystals could be observed. On examination of some of the acicular forms with the polarizing microscope the usual characters were observed with the exception that a red variety occurred which does not seem to have been hitherto mentioned. These crystals are characterized by a brownish-red color, occur in tufts, and the individuals average from .5 to 2 mm. in length. They are transparent and of marked brownish-red color but show little or no pleochroism.

ORPIMENT

MERCUR, UTAH

PLATES XLIV AND LIII

Among the specimens obtained from Maynard Bixby, orpiment from Mercur, Utah, was represented by an especially notable one, (Mus. No. M 8206). This specimen consisted of a piece of limestone about 3x4 inches in size, upon which were implanted about fifteen large crystals of orpiment together with fragments of orpiment crystals and numerous crystals of calcite. The size and perfection of many of the orpiment crystals seem to exceed any that have

been hitherto described. The largest of the crystals measure 20 millimeters in length by 17 millimeters in width, and from this they diminish to about one-half this size. They are arranged upon the matrix in a nearly parallel position though not exactly so. The mode of attachment may be in general stated to be that of the lower end of the vertical axis, though this attachment varies somewhat. The crystal planes do not present brilliant surfaces, but though dull are not rounded. They do not afford sharp signals with the reflecting goniometer, but give tokens sufficiently well defined so that very close estimates of the angular values can be obtained. The cleavage parallel to the clinopinacoid is, as usual, very strongly marked. This cleavage affords reflections which are sharp but vicinal. The color of the crystals is a dark orange-red, on cleavage surfaces bright golden-yellow. The crystals are opaque. In development the crystals exhibit monoclinic symmetry throughout and leave little doubt that orpiment should be considered as crystallizing in this system. They are all of the same habit and one which seems to be new for this mineral. It is especially characterized by the large development of the positive pyramid ν ($\bar{3}43$). This occurs in broad planes, sometimes 1.5 cm. in length by 1 cm. in width. Grouped with this pyramid occurs in greater or less development the pyramid v($\bar{1}21$). Accompanying this occur several prisms and in less prominent development several other pyramids. The habit generally exhibited is illustrated in Fig. 1, Pl. LIII, the crystal being drawn in the normal position. As this position is not, however, favorable to exhibiting the positive pyramid, Fig. 2, Pl. LIII, shows the crystal drawn in reverse position. Three forms new to orpiment were detected upon the crystals. These were the 3/2 clinodome, 023, designated as *l*, the 1/3 negative pyramid $\bar{1}33$ designated as *n*, and the 1/3 positive orthodome $\bar{1}03$ designated as *d*. In addition two forms were noted which had been observed by Stevanovic,* but to which he had assigned no letters, apparently because he did not regard his results as conclusive. These forms were the 1/3 negative orthodome 103 to which the letter *e* has been assigned, and the positive pyramid $\bar{1}23$ to which the letter *k* has been assigned. The habit of the Mercur crystals, it may be noted, somewhat resembles that of one figured by Stevanovic† from Allchar except that in the crystal figured by him, the prisms are the prominent forms instead of the pyramids. A basal projection showing the usual development of the different forms found upon the Mercur specimen is given

*Zs. Kr., 1904, 39, p. 14.

†Loc. cit. Fig. 3.

in Fig. 3, Pl. LIII. In calculating the forms the axial ratios established by Stevanovic have been employed rather than those of Mohs. These values are as follows:

$$a : b : c \quad = \quad 0.5962 : 1 : 0.665 \qquad \beta = 90° \; 41'$$

The following is a list of the forms observed on the Mercur orpiment, those marked with an asterisk being new:

a (100)	e (103)	q $(\bar{4}49)$
b (010)	*d $(\bar{1}03)$	k $(\bar{1}23)$
m (110)	*l (023)	*n $(\bar{1}33)$
u (120)	ν $(\bar{3}43)$	i (243)
o (101)	v $(\bar{1}21)$	

				Observed	Calculated
$b \wedge o$	=	$(010) \wedge (101)$	=	90° 28′	90° 00′
$a \wedge m$	=	$(100) \wedge (110)$	=	31° 2′	30° 48′
$a \wedge u$	=	$(100) \wedge (120)$	=	50° 10′	50° 1′
$a \wedge o$	=	$(100) \wedge (101)$	=	41° 19′	41° 35′
$a \wedge e$	=	$(100) \wedge (103)$	=	70° 8′	69° 14′
$e \wedge d$	=	$(103) \wedge (\bar{1}03)$	=	40° 58	41° 32′
$b \wedge l$	=	$(010) \wedge (023)$	=	65° 23′	66° 5′
$o \wedge l$	=	$(101) \wedge (023)$	=	54° 35′	53° 14′
$\nu \wedge \nu'$	=	$(\bar{3}43) \wedge (3\bar{4}3)$	=	61° 34′	61° 32′
$v \wedge v'$	=	$(\bar{1}21) \wedge (\bar{1}\bar{2}1)$	=	82° 58′	83° 32′
$b \wedge n$	=	$(010) \wedge (\bar{1}33)$	=	59° 45′	58° 21′
$o \wedge n$	=	$(101) \wedge (\bar{1}33)$	=	70° 35	72° 22′
$b \wedge k$	=	$(010) \wedge (\bar{1}23)$	=	68° 41′	67° 44′
$o \wedge k$	=	$(101) \wedge (\bar{1}23)$	=	70° 00′	70° 48′
$b \wedge q$	=	$(010) \wedge (\bar{4}49)$	=	75° 52′	75° 6′
$b \wedge i$	=	$(010) \wedge (243)$	=	54° 21′	54° 43′
$o \wedge i$	=	$(101) \wedge (243)$	=	36° 17′	36° 50′

In connection with these crystals the well-known crystals * from this locality occurring in cavities in clay were examined. These crystals are of smaller size and are for the most part obviously twins but their planes were found to be so poorly developed that no satisfactory measurements could be obtained.

* App. Dana's Mineralogy, 1899, p. 50.

PHENACITE

NORTH CHATHAM, NEW HAMPSHIRE

The first published mention of phenacite from this locality seems to have been by Kunz in 1890* This brief mention may be repeated here:

"In May, 1888, E. A. Andrews, of Stow, Me., discovered some crystals of phenacite on Bald Mountain†, North Chatham, N. H., near the State line between Maine and New Hampshire and in the neighborhood of Stoneham, Me. They were found in a vein of coarse albitic granite, associated with crystals of smoky quartz, topaz and muscovite, some implanted on smoky quartz, and a few attached so loosely to the matrix by one of the rhombohedral faces that they could be removed without being broken. They were about fifty in number, lenticular in shape, and measured from 1/8 inch to 1/2 inch (3 mm. to 12 mm.) across, and from 1-25 inch to 1/8 inch (1 mm. to 3 mm.) in thickness. They were all white or colorless, with polished faces, and for the most part very simple in form."

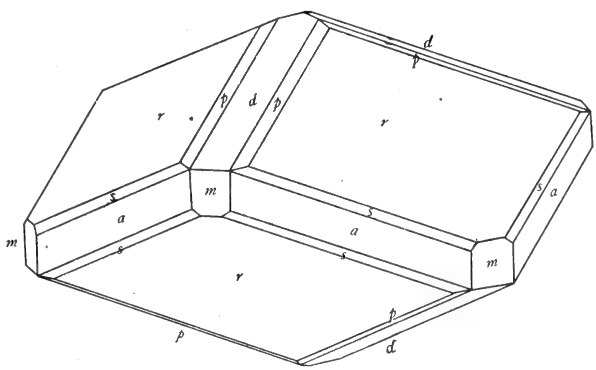

FIG. 4. Phenacite.

No crystallographic investigation seems to have been undertaken by Kunz and no further mention of the occurrence has been made so far as the writers are aware. The Museum is in possession of three specimens of phenacite from this locality. In two of the specimens single phenacite crystals are implanted on crystals of smoky quartz. The phenacite crystals of these specimens are about 10 mm. in diameter and 5 mm. thick. They are whitish in color and semitransparent. They exhibit the lenticular habit mentioned by Kunz, this habit being produced by the prominence of the rhombohedron r $(10\bar{1}1)$.

* Gems and Precious Stones of North America, 1890, p. 100.

† The correct name of the mountain is Bald Face Mountain.—O. C. F.

This is also usually truncated by the positive ½ rhombohedron *d* (01$\bar{1}$2). The unit prism *m*, (10$\bar{1}$0) also appears as small planes. The third specimen (Mus. No. M 10276) consists of a large crystal of orthoclase 3 x 5 inches in size more or less intergrown with albite, and showing also three crystals of topaz 2 to 3 inches in length. Scattered about upon the albite and orthoclase about 50 crystals of phenacite occur. These vary in diameter from 1 cm. to 1 mm. All are whitish to colorless, the larger crystals tending to be semitransparent and the small ones perfectly transparent. In habit all show the lenticular shape previously described, which is produced by the forms already mentioned. Many of the smaller crystals, however, are more highly modified than the large ones and the planes being brilliant and giving good reflections afford easy identification of the forms. The following is a list of the forms observed and some of the measurements obtained:

m (10$\bar{1}$0)	*d* (01$\bar{1}$2)	*s* (21$\bar{3}$1)
a (11$\bar{2}$0)	*p* (11$\bar{2}$3)	s_1 (3$\bar{1}\bar{2}$1)
r (10$\bar{1}$1)		

				Observed	Calculated
$a \wedge r$	=	(11$\bar{2}$0) $\wedge$ (10$\bar{1}$1)	=	58° 14′	58° 18′
$r \wedge p$	=	(10$\bar{1}$1) $\wedge$ (11$\bar{2}$3)	=	20° 11′	20° 4′
$r \wedge m$	=	(10$\bar{1}$1) $\wedge$ (10$\bar{1}$0)	=	52° 41′	52° 39′
$m' \wedge d$	=	(01$\bar{1}$0) $\wedge$ (01$\bar{1}$2)	=	68° 35′	69° 7′
$r \wedge d$	=	(10$\bar{1}$1) $\wedge$ (01$\bar{1}$2)	=	31° 35′	31′ 42′
$r \wedge s$	=	(10$\bar{1}$1) $\wedge$ (21$\bar{3}$1)	=	30° 17′	29° 57′
$s \wedge s_1$	=	(21$\bar{3}$1) $\wedge$ (12$\bar{3}\bar{1}$)	=	55° 40′	56° 42′

The appearance of one of the crystals is shown in the accompanying figure, Fig. 4, it having been drawn as is usual with phenacite, with the negative rhombohedrons in front.

REALGAR

MERCUR, UTAH

PLATES XLIV AND LIV

Among other specimens from Mercur, Utah, obtained from Maynard Bixby, two exhibiting realgar deserve especial mention. In one of these specimens (Mus. No. M 8204), the realgar occurs as small crystals partially filling a narrow fissure in limestone: in the other (Mus. No. M 8205) it occurs as elongated prisms intergrown with

large and small calcite crystals. The color of the realgar in both specimens is a superb carmine-red. The crystals are transparent. The habit of the crystals in the specimen numbered M 8204 is, as is usual with realgar, short-prismatic. These crystals are highly modified and doubly terminated. A marked feature is the large number of prisms present, no less than nine being observed. The planes are remarkably brilliant and afford excellent signals on the reflecting goniometer. The prisms are often scarcely more than lines, but nevertheless give well-defined signals with the goniometer. In some of the crystals the basal plane is quite prominent, while in others pyramids and clinodomes are extensively developed. The clinopinacoid may also be quite fully developed. The two most prominent types exhibited by these crystals are shown in Figs. 1 and 2, Pl. LIV. As there represented, a slight elongation in the direction of the clino-axis usually occurs. The crystals average about 4 mm. in length.

The specimen numbered M 8205 is from the Golden Gate mine. In habit the crystals of this specimen seem to be different from any hitherto noted in realgar in that the prism is elongated in the direction of the vertical axis. None of these crystals is doubly terminated. The terminations on the single terminated end are simple as compared with those of the crystals previously described and there is no large number of prisms present. The prismatic development here is produced chiefly by the prisms *m* (110) and *l* (210). Like the crystals previously described these crystals also show a slight elongation in the direction of the clino-axis. The average length in this direction is about 7 millimeters. In the direction of the vertical axis a length of 15 millimeters is frequently exhibited. Fig. 3, Pl. LIII, illustrates these crystals. Some of the smaller crystals of this specimen are hollow in the direction of their length. A basal projection of all the forms observed upon both specimens is given in Fig. 4, Pl. LIV.

The following is a list of the forms observed, together with measured and calculated angles:

a (100)	*z* ($\bar{2}$01)	*v* (230)
b (010)	*h* (610)	*μ* (120)
c (001)	*l* (210)	*δ* (250)
q (011)	*β* (320)	*f* (212)
r (012)	*w* (430)	*e* ($\bar{1}$11)
y (032)	*η* (650)	*n* ($\bar{2}$12)
x ($\bar{1}$01)	*m* (110)	

				Observed	Calculated
$b \wedge h$	=	$(010) \wedge (610)$	=	77° 48′	77° 38′
$b \wedge l$	=	$(010) \wedge (210)$	=	56° 37′	56° 38½′
$b \wedge \beta$	=	$(010) \wedge (320)$	=	48° 38′	48° 44′
$b \wedge w$	=	$(010) \wedge (430)$	=	45° 21′	45° 22′
$b \wedge \eta$	=	$(010) \wedge (650)$	=	42° 13′	42° 21′
$b \wedge m$	=	$(010) \wedge (110)$	=	37° 12′	37° 13′
$b \wedge v$	=	$(010) \wedge (230)$	=	26° 52′	26° 51′
$b \wedge \mu$	=	$(010) \wedge (120)$	=	20° 47′	20° 48′
$b \wedge \delta$	=	$(010) \wedge (250)$	=	17° 10′	16° 54′
$c \wedge r$	=	$(001) \wedge (012)$	=	24° 3′	23° 58′
$c \wedge q$	=	$(001) \wedge (011)$	=	41° 32′	41° 39′
$c \wedge y$	=	$(001) \wedge (032)$	=	53° 5′	53° 8′
$c \wedge f$	=	$(001) \wedge (212)$	=	30° 56′	30° 51′
$c \wedge n$	=	$(001) \wedge (\bar{2}12)$	=	46° 13′	46° 20′
$b \wedge e$	=	$(010) \wedge (\bar{1}11)$	=	47° 3′	46° 59′
$b \wedge n$	=	$(010) \wedge (\bar{2}12)$	=	65° 5′	64° 59′
$b \wedge x$	=	$(010) \wedge (\bar{1}01)$	=	90° 20′	90° 00′
$c \wedge z$	=	$(001) \wedge (\bar{2}01)$	=	69° 36′	69° 53′

RUTILE

JEQUITINHONHA RIVER, BRAZIL

FIG. I, PLATE LI

Several crystals of rutile of an interesting habit were presented to one of the authors by Olaf E. Ray, Esq., of the Chicago Brazilian Diamond Company. The crystals were obtained by Mr. Ray from sands washed for diamonds on the Jequitinhonha River near Diamantina, Brazil. The crystals are twins ranging from 9 mm. to 13 mm. in length and 8 to 10 mm. in width in the direction of one lateral axis while in the direction of the other lateral axis their thickness is only 2 to 3 mm. The crystals have the typical brownish-black color of rutile and are practically opaque but occasionally are dark-red by transmitted light. The planes are splendent. Examination by the reflecting goniometer shows the crystals to be made up of the ditetragonal prism *h* (210) and the pyramid of the second order *e* (101). The development of the planes of the pyramid is not uniform, two planes always being larger than the other two. The twinning plane is *v* (301). The prismatic planes are frequently striated parallel to the prismatic edges and hence

usually give successive signals. Fig. 1, Pl. LI, exhibits the usual development. In addition it may be noted that one individual of the twin usually shows a tendency to grow by the other, suggesting a penetration twin; but the growth is never extended far. Determination of the specific gravity gave 4.284 The forms and measurements observed are as follows:

h (210) *e* (101)

			Observed	Calculated
$h \wedge h'$	= (210) $\wedge$ (120)	=	36° 13′	36° 52′
$h \wedge h^{vii}$	= (210) $\wedge$ $(2\bar{1}0)$	=	52° 10′	53° 8′
$e \wedge e''$	= (101) $\wedge$ $(\bar{1}01)$	=	65° 38′	65° 35′
$e \wedge e$ of twin		=	54° 12′	54° 42′

SPHALERITE

TUCKAHOE, MISSOURI

As is well known, sphalerite occurs in the Joplin district in the form of small crystals in clay, and occasionally in sufficient abundance to be used as an ore. Mr. James Roach of Tuckahoe, Missouri, who mines ore of this character, kindly selected about 25 of the best crystals and presented them to the Museum, Mus. No. M 6382. The crystals are of interest as showing an unusual habit for sphalerite and one which is in some respects difficult of interpretation. The crystals range from 5 to 20 mm. in diameter and are of a generally tetrahedral form. In color some, generally the smaller ones, are reddish-brown and nearly transparent, but the majority are dark-colored and opaque. The development of the crystal planes varies from almost indiscriminate rounding to well-defined. All the crystals however, as stated, show a general tetrahedral form. Now and then apparent re-entrant angles are to be seen, which suggest that the crystals are probably twins; but on breaking the crystals no differences of cleavage can be observed to confirm this supposition. As a rule the crystals are made up of only fifteen planes, but occasionally eighteen can be observed. None of the planes are sufficiently brilliant to give measurements with the reflecting goniometer, but the crystals are of such size that satisfactory results can be obtained with the contact goniometer. By study of the crystals in this manner the presence of the tetrahedron and cube can be definitely and satisfactorily determined. These forms are always present in their full num-

ber of planes. Moreover, the character of their planes is distinctive, the tetrahedrons being always more or less rough from etching and pitting and the cubical faces usually smooth and often more brilliant than the other planes. The remaining planes show an angular measurement upon the cube and tetrahedron corresponding to that of planes of the hemitetragonal tristetrahedron p $(2\bar{2}1)$, but the full number of planes of this form is never present. As a rule a single plane of the form occurs in three quadrants and two in the fourth. One crystal, however, exhibits two planes of the form in each quadrant. It is of interest to note that in the pyrite described by Penfield from French Creek, Pennsylvania * a somewhat similar lack of planes occurs. Owing to the etched character of the tetrahedral faces on the sphalerite it is probable that the tetrahedron present is the positive one and the tristetrahedron is therefore to be regarded as negative. Fig. 5 illustrates the development exhibited by the majority of the crystals. The crystals with rounded planes have as a whole more nearly the appearance of the tetragonal tristetrahedron than those which are more fully developed. The tristetrahedron may therefore be regarded as in a sense the fundamental form which is modified in the more fully developed crystals by the cube and tetrahedron. A list of the forms and angles follows:

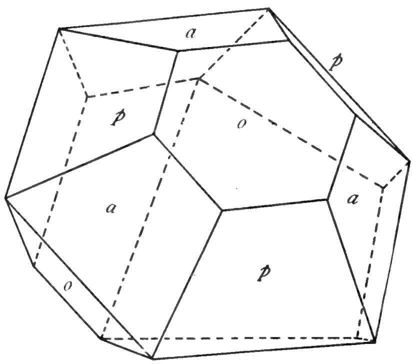

FIG. 5. Sphalerite.

a (100) o (111) p $(2\bar{2}1)$

	Observed		Calculated
$a \wedge o = (100) \wedge (111)$	$= 55° 12'$	(average of 11 measurements)	$54° 44'$
$a \wedge p = (\bar{1}00) \wedge (\bar{2}21)$	$= 48° 14'$	" " 15 "	$48° 11'$
$a \wedge p = (001) \wedge (\bar{2}21)$	$= 70° 00'$	" " 6 "	$70° 31'$

* Am. Jour. Sci., 1889 (3), 37, p. 209.

VIVIANITE

SILVER CITY, IDAHO

A crystal of vivianite of unusual size and transparency, Mus. No. M 9454, from Silver City, Idaho, was received from Maynard Bixby. The crystal, attached to a group of small quartz crystals, constitutes the only specimen of the occurrence known to the writers. This crystal is transparent and dark-green in color by transmitted light but by reflected light in certain positions appears azure-blue. It is prismatic in habit and elongated both in the direction of the *c* and *b* axes. Its length in the direction of the *c* axis is 3.5 cm., in that of the *b* axis 1.7 cm., and in that of the *a* axis 1.1 cm. It is completely developed except for the terminations of one end of the vertical axis. Measurements made partly with the reflecting and partly with the contact goniometer show the following forms and angles:—

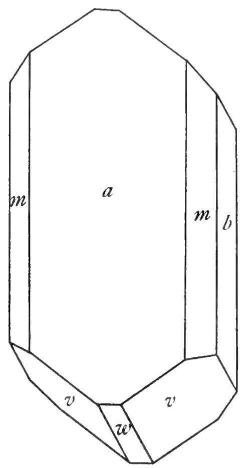

FIG. 6. Vivianite.

a (100), b (010), m (110), w ($\bar{1}01$), v ($\bar{1}11$).

				Observed	Calculated
$a \wedge m$	=	(100) $\wedge$ (110)	=	36° 30′	35° 59′
$a' \wedge w$	=	($\bar{1}00$) $\wedge$ ($\bar{1}01$)	=	56°	54° 40′
$b \wedge v$	=	(010) $\wedge$ ($\bar{1}11$)	=	58°	60° 13′

The development of the crystal is illustrated in the accompanying figure, Fig. 6.

Plate XLV.

Anglesite.

EUREKA, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *δ* (230), *n* (120), *o* (011), *r* (112), *z* (111), *τ* (221), *p* (324), *y* (122).

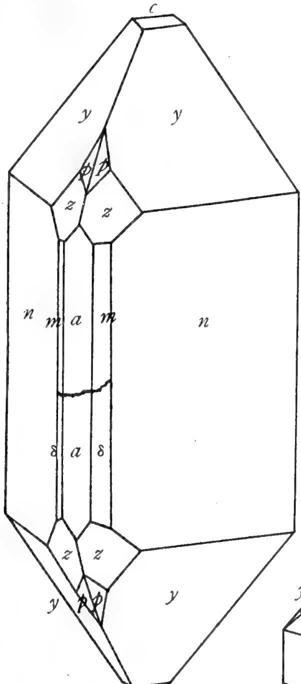

Fig. 4

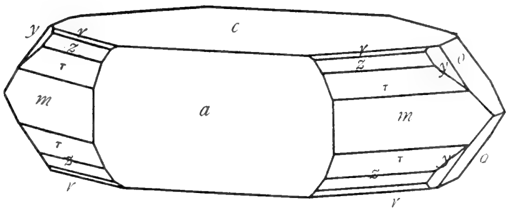

Fig. 1

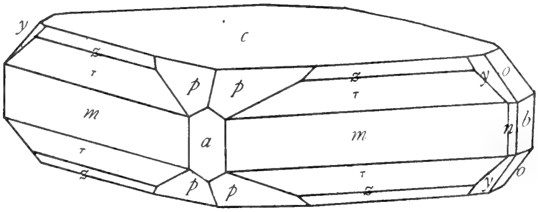

Fig. 2

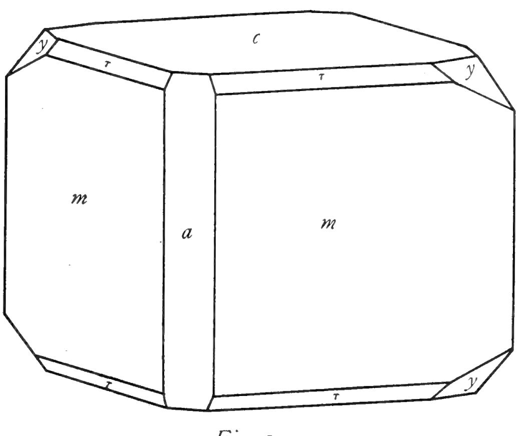

Fig. 3

PLATE XLVI.

ANGLESITE.

EUREKA, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), M (410), *n* (120), *o* (011), *d* (102), (104), *z* (111), *p* (324), *y* (122), *μ* (124).

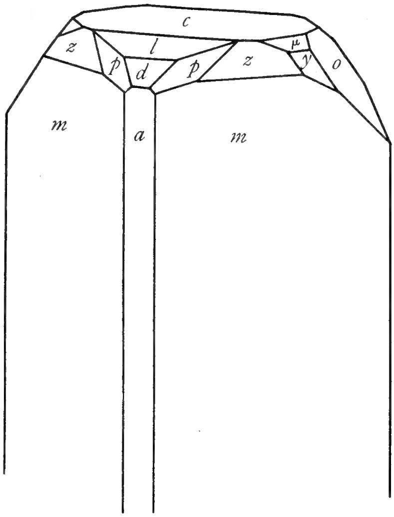

Fig. 1

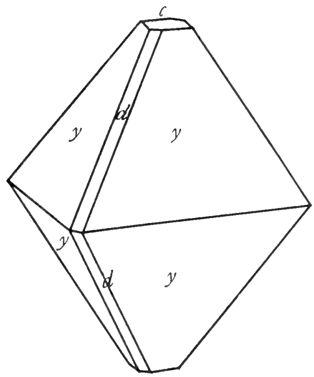

Fig. 5

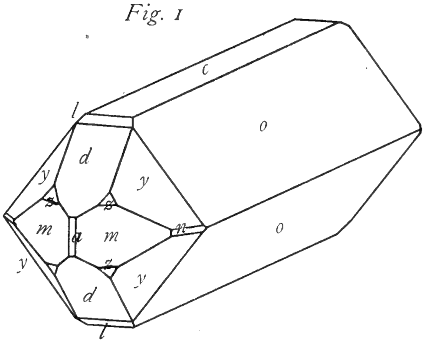

Fig. 2

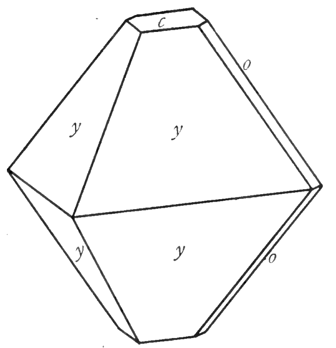

Fig. 4

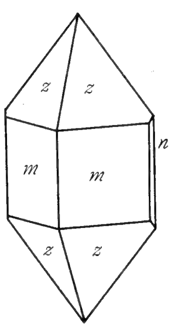

Fig. 6

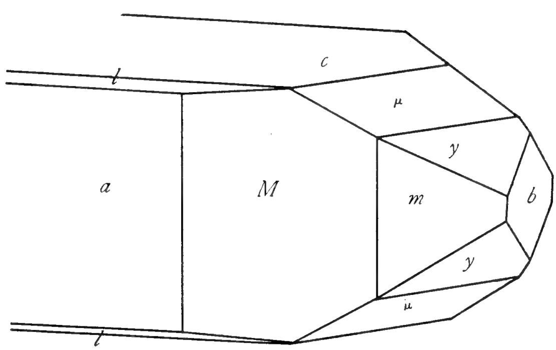

Fig. 3

PLATE XLVII.

Figs. 1–3.

BARITE.

CARTERSVILLE, GEORGIA.

Forms: *a* (100), *c* (001), *m* (110), *n* (120), χ (130), λ (210), *o* (011), *z* (111), *f* (113), *q* (114), *y* (122).

Figs. 4–5.

BERTRANDITE.

ALBANY, MAINE.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *f* (130), *l* (203).

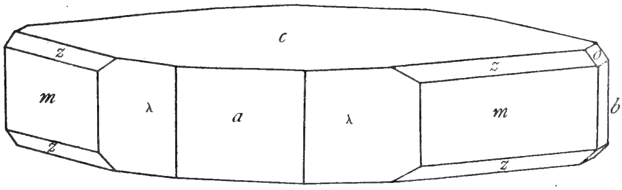

Fig. 1

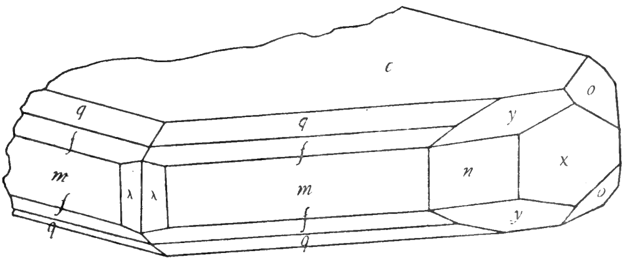

Fig. 2

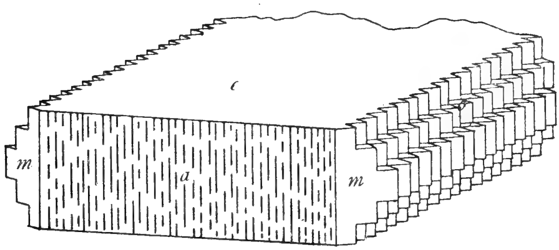

Fig. 3

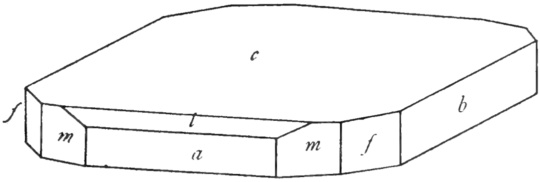

Fig. 4

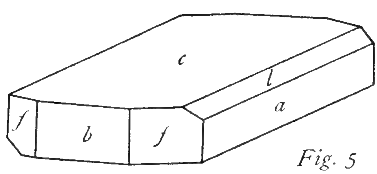

Fig. 5

PLATE XLVIII.

Fig. 1.

CALCITE.

CRYSTAL PALACE MINE, CENTRAL CITY, MISSOURI.

Forms: *e* $(01\bar{1}2)$, *υ*. $(05\bar{5}3)$, *M* $(40\bar{4}1)$, *v* $(21\bar{3}1)$.

Fig. 2.

CALCITE.

CUBAN MINE, JOPLIN, MISSOURI.

Forms: *r* $(10\bar{1}1)$, *μ* $(54\bar{9}1)$, *J*: $(52\bar{7}3)$, 𝔅: $(51\bar{6}1)$, *G*: $(72\bar{9}5)$, *z* $(12\bar{3}5)$, Δ $(23\bar{5}2)$.

The letters followed by dots are Goldschmidt's; those without dots, Dana's.

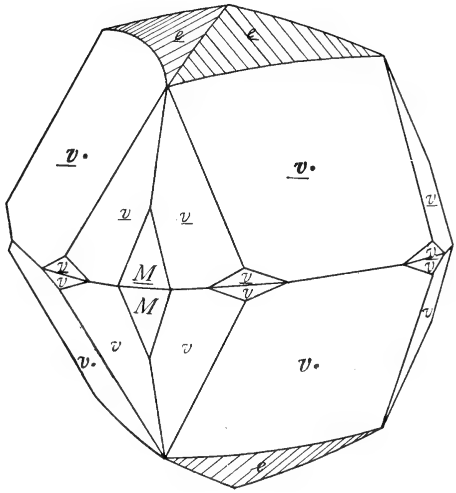

Fig. 1

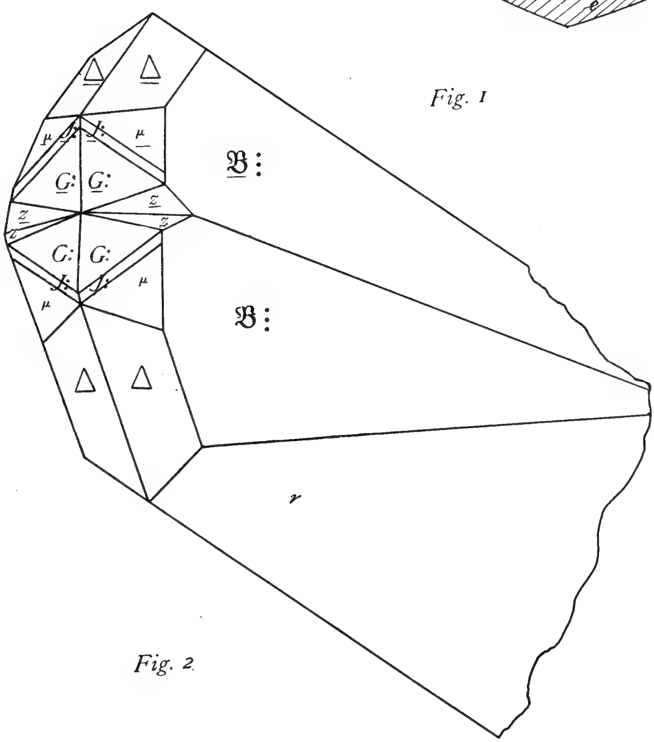

Fig. 2

PLATE XLIX.

Fig. 1.

CALCITE.

BELLEVUE, OHIO.

Forms: π $(11\bar{2}3)$, a $(44\bar{8}3)$, γ $(8.8.\bar{16}.3)$, r $(10\bar{1}1)$, μ: $(20.11.\bar{31}.11)$.

Fig. 2.

CALCITE.

BLACKBERRY MINE, JOPLIN, MISSOURI.

Forms: e $(01\bar{1}2)$, f $(02\bar{2}1)$, M $(40\bar{4}1)$, t $(21\bar{3}4)$, v $(21\bar{3}1)$, E $(41\bar{5}6)$, ν: $(11.4.\bar{15}.3)$.

The letters followed by dots are Goldschmidt's; those without dots, Dana's.

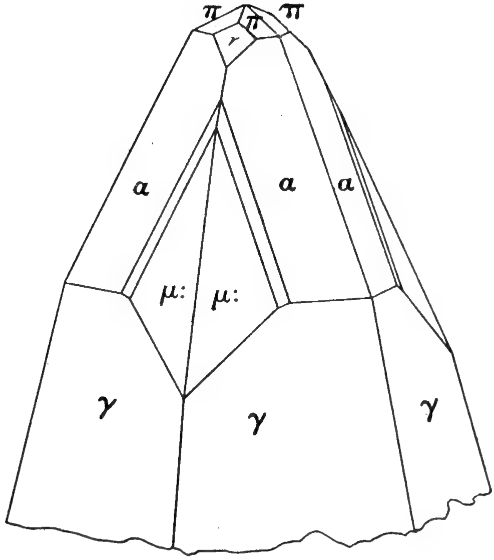

Fig. 1

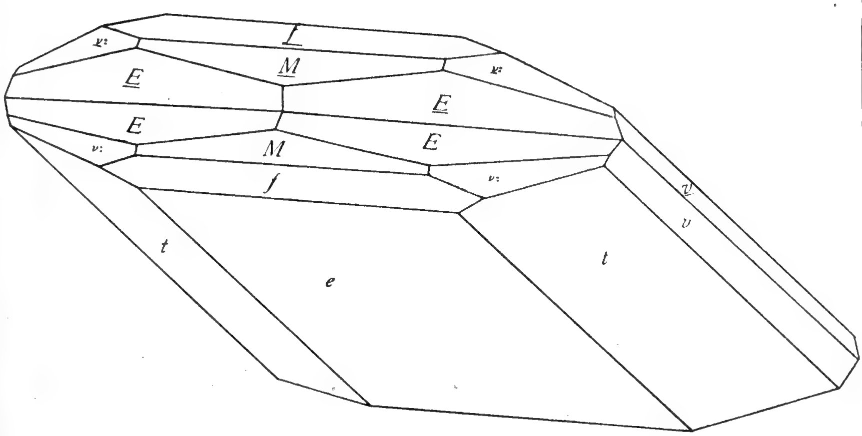

Fig. 2

PLATE L.

Fig. 1.

LEADHILLITE.

SHULTZ, ARIZONA.

Forms: *t* (112), *f* ($\bar{1}01$).

Fig. 2.

LINARITE.

EUREKA, UTAH.

Forms: *a* (100), *c* (001), *m* (110), *r* (011), δ (10.0.9), ψ ($\bar{9}.0.10$), *x* ($\bar{3}02$), μ ($\bar{2}01$), *g* ($\bar{2}11$), *f* ($\bar{5}23$).

Fig. 3.

LINARITE.

EUREKA, UTAH.

Projected on the clinopinacoid.

Figs. 4–5.

MIMETITE.

EUREKA, UTAH.

Forms: *c* (0001), *m* ($10\bar{1}0$), *x* ($10\bar{1}1$).

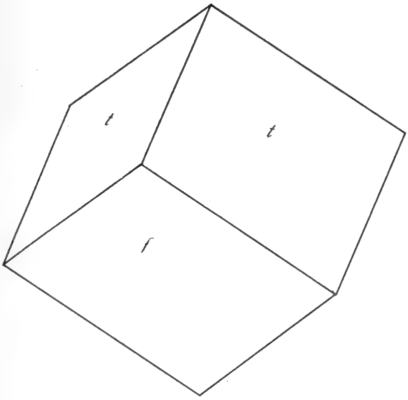

Fig. 1

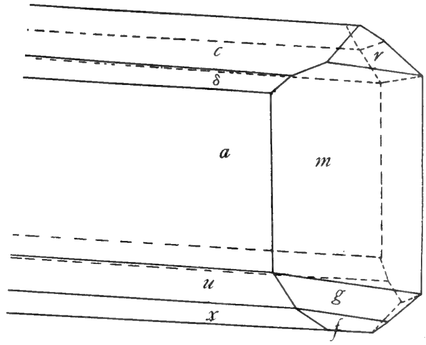

Fig. 2

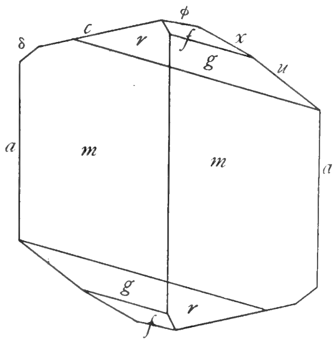

Fig. 3

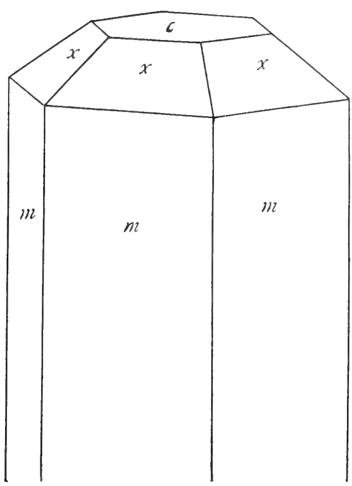

Fig. 4

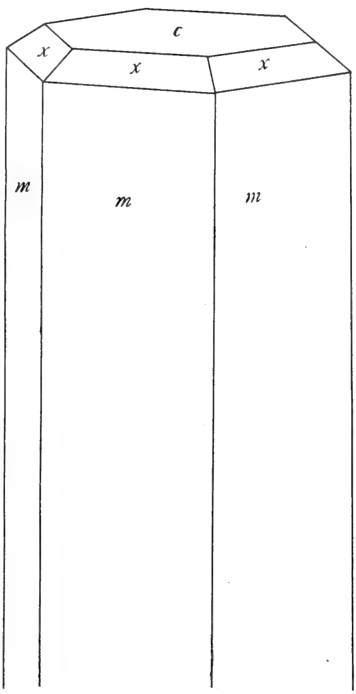

Fig. 5

PLATE LI.

Fig. 1.

RUTILE.

JEQUITINHONHA RIVER, BRAZIL.

Forms: *h* (210), *e* (101).

OCTAHEDRITE.

Figs. 2–4.

JEQUITINHONHA RIVER, BRAZIL.

Forms: *c* (001), G (104), *p* (111), *r* (115), *v* (117), M (338), s_1 (5.1.19).

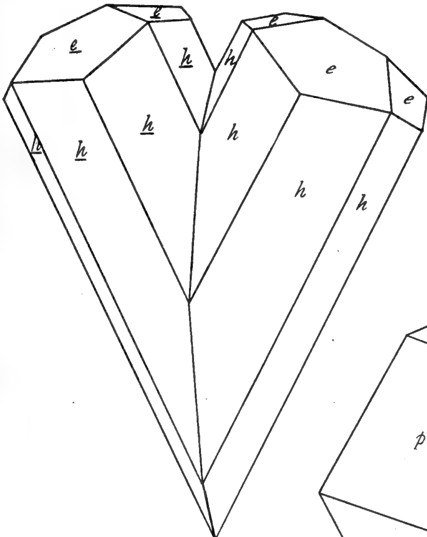

Fig. 1

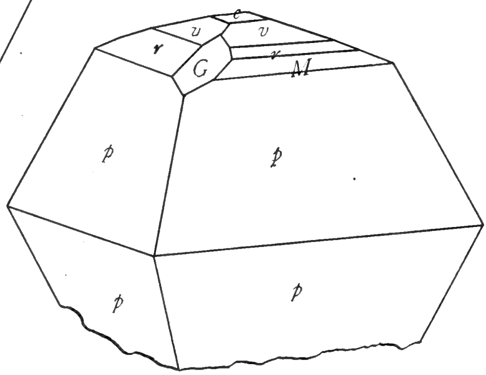

Fig. 2

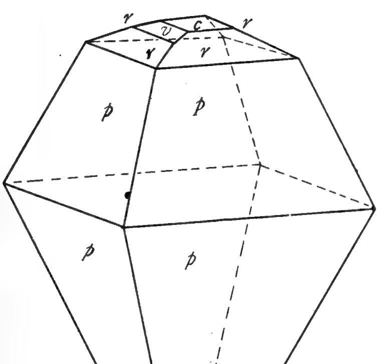

Fig. 3

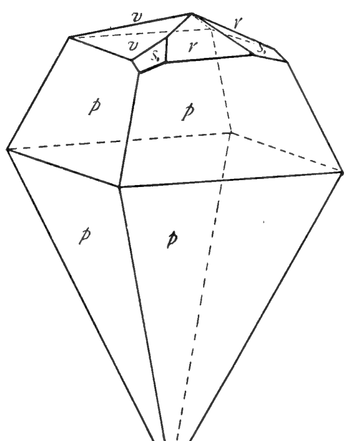

Fig. 4

PLATE LII.

OLIVENITE.

TINTIC DISTRICT, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *m* (110), *v* (101), *e* (011), *s* (034), *d* (025).

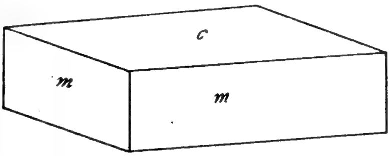

Fig. 3

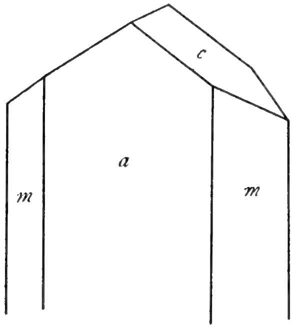

Fig. 5

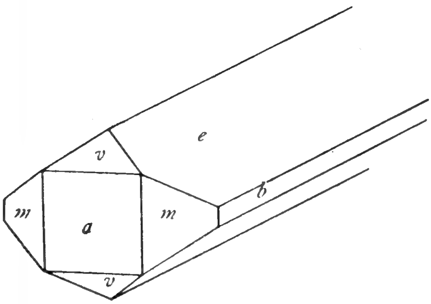

Fig. 4

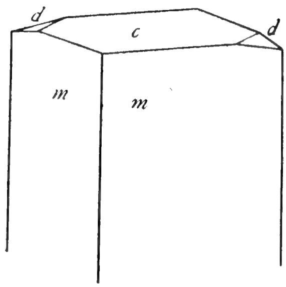

Fig. 2

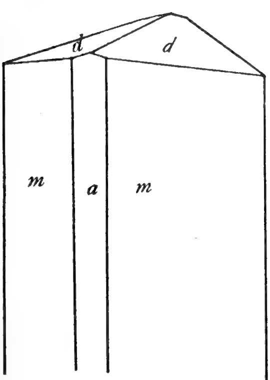

Fig. 1

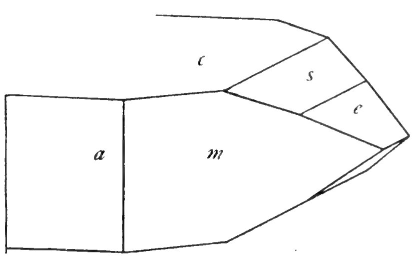

Fig. 6

Plate LIII.

Fig. 1.

Orpiment.

MERCUR, UTAH.

Forms: *a* (100), *b* (010), *m* (110), *u* (120) *o* (101), *e* (103), *d* ($\bar{1}03$), *l* (023) *ν* ($\bar{3}43$), *v* ($\bar{1}21$), *q* ($\bar{4}49$), *k* ($\bar{1}23$), *n* ($\bar{1}33$), *i* (243).

Fig. 2.

Orpiment.

MERCUR, UTAH.

Drawn with positive forms in front.

Fig. 3.

Orpiment.

MERCUR, UTAH.

Basal projection of forms observed.

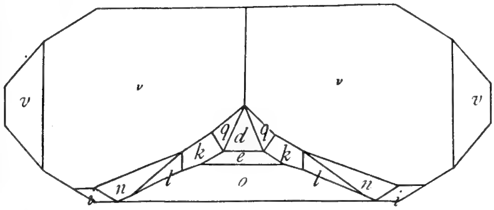

Fig. 3

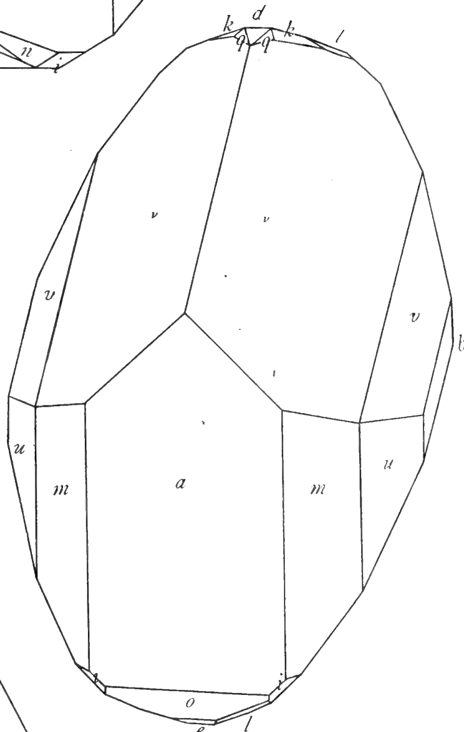

Fig. 2

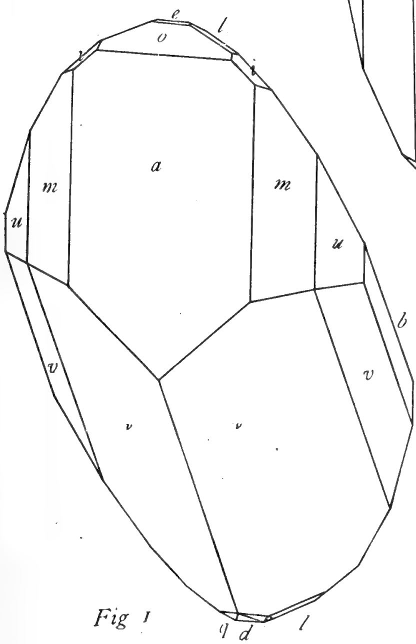

Fig. 1

PLATE LIV.

Figs. 1–3.

REALGAR.

MERCUR, UTAH.

Forms: *a* (100), *b* (010), *c* (001), *q* (011), *r* (012), *y* (032), *x* ($\bar{1}01$), *z* ($\bar{2}01$), *h* (610), *l* (210) β (320), *w* (430), η (650), *m* (110), *v* (230), μ (120), δ (250), *f* (212), *e* ($\bar{1}11$), *n* ($\bar{2}12$).

Fig. 4.

REALGAR.

MERCUR, UTAH.

Basal projection of forms observed.

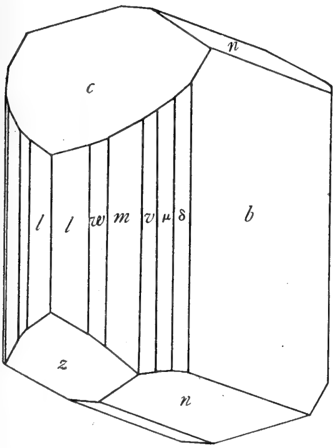

Fig. 1

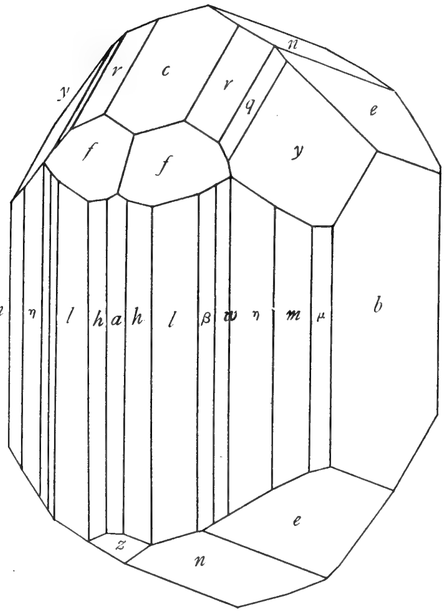

Fig. 2

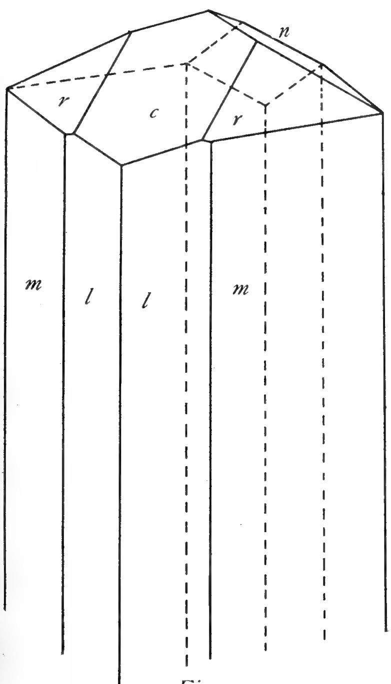

Fig. 3

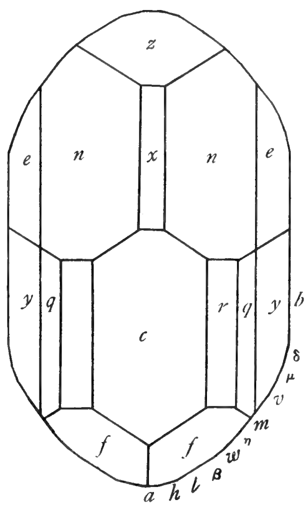

Fig. 4

METEORITE STUDIES. III.

BY OLIVER CUMMINGS FARRINGTON.

LEIGHTON.

This meteorite fell at 8 P. M., Sunday, January 12, 1907, eight miles south of Leighton, Colbert County, Alabama. The exact place of fall was near the old Bethel church in township 5, range 10, west of the Huntsville meridian. So far as is known to the writer only a single stone of the fall is preserved. To Dr. A. Graves of Leighton and Professor E. A. Smith of the University of Alabama the Museum is indebted for such information as it possesses regarding the fall. According to Dr. Graves the meteor which produced the meteorite passed over the region with a mighty roar which ended in a report something like pistol-firing in rapid succession and from which "particles flew like sparks from a coal of fire." A stone from this meteor struck in the yard of the residence of Mrs. M. D. Allen. Mrs. Allen and her daughter Mattie were standing on their front porch and saw the meteor, heard the explosion, then heard a whizzing in the air and the striking of a stone in the yard. On going to the place they found the stone which is now preserved, sunken to the depth of about 12 inches. This stone weighed one pound and fifteen ounces (877 grams). About one ounce was chipped off from one corner by the parties who found the stone, in order to examine its interior. Accordingly the weight of the stone as received by the Museum was one pound and fourteen ounces (850 grams). The shape and size of the stone may be roughly described as like that of a man's fist. It is shown in Fig. 1, Plate LV. The greatest length is 4 inches (10 cm.), the height 2½ inches (6 cm.). About three-fourths of the surface is covered with crust, the remainder has a rough, irregular, fractured appearance. The lack of crust on part of the uncrusted surface is probably due to the breaking done by the finders, the remainder perhaps represents a fracture of the stone in the air. The large fractured surface is roughly triangular in shape with sides about 3 inches (7.5 cm.) in length. The encrusted surfaces of the stone are all smoothed

and rounded. They are either convex or concave. The convex surfaces are of comparatively uniform slope, the concave, irregular and showing depressions resembling pittings, though these are rarely as well-defined as is usual in meteorites. Five of these pits which occur together in one concavity are approximately circular in outline, shallow, and have a diameter of about one centimeter each. On another portion of the stone two similar but smaller pits may be seen and on another portion a larger, crescent-shaped pit. Nothing in the shape or markings of the stone indicates orientation during flight. The general shape of the stone is, as already noted, irregular and the crust remarkably uniform in appearance. In color the crust is dull black with occasionally an inclination to a reddish shade. Seen under the lens it presents a porous, slaggy appearance with no indications of flow. The indications are that the surface fused in place. The pores of the slag are very minute and the crust strongly adherent. Grains of nickel-iron rounded by fusion can be seen here and there and occasionally spots from one to three millimeters in diameter having smoother crust appear. These doubtless indicate portions which for some reason fused somewhat more readily. The color of the interior of the stone is in general brownish-black resembling the black chondrites. A marked feature (shown in Fig. 2, Plate LV.) is that of large spots of a much lighter color scattered over the dark ground. These are best seen on polished sections. The color of these spots is a light gray, and so much lighter than the mass of the meteorite as to be very prominent. The spots vary in size, the largest seen covering nearly one square inch of surface. The outline of the spots is irregular but not strongly so, and tends to be curved rather than straight. There seems to be no indication megascopically of any separation other than that of color, of the substance of these spots from the remainder of the mass. The section in which they are best exhibited and that illustrated in Fig. 2, Plate LV, was made near one end of the meteorite. On a section parallel to this made about one centimeter nearer the interior, the larger spots while retaining their relative position were found to be much smaller, less than half the size of those on the outer section. They do not, therefore, extend uniformly through the meteorite. As solid bodies their shape is probably somewhat lens-like or flat-pyramidal. One spot which was small on the outer section was about twice as large on the inner section. Hence the spots are probably to be found scattered irregularly through the meteorite. The structure of the meteorite on the whole in respect to these spots is the same as that designated by Bre-

zina as breccia-like. This term should be understood however, in the same sense in which Brezina uses it, i. e., as an imitation of brecciated structure, without an actual clastic origin being assumed.* The writer knows of no meteorite in which this structure is so strongly marked as in Leighton. Besides the spotting already referred to, the dark mass of the meteorite is also speckled by numerous chondri of various sizes and shapes but in general more or less circular in outline and ranging from 2 mm. in diameter down. The color of these closely resembles that of the light-colored spots just referred to. There is also a thick sprinkling of metallic grains. These are as a rule small, independent of each other and very irregular in outline. Some of the larger ones are elongated, one seen being 4 mm. long and 7 mm. wide. The distribution of the metallic grains as a whole is comparatively uniform, except that they tend to encircle the chondri. Troilite is to be seen in the form of grains, but is much less abundant than nickel-iron. At one point, however, a large nodule of a somewhat crescentic form occurs which has a length of 11 millimeters and a width of 5 millimeters. This troilite is of bronze-yellow color, brittle, and slightly magnetic.

The texture of the stone is firm and compact so that it breaks with difficulty and takes an excellent polish. The specific gravity obtained by weighing the whole stone was 3.604.

Under the microscope, chondri appear to be much more numerous in the dark-colored than in the light-colored portions of the sections. This difference is doubtless in part due to the greater contrast in which the chondri are thrown by the dark-colored background, but there is also a real relative scarcity of chondri in the light-colored portions. The line of demarcation between the light and dark-colored portions is as sharply distinguished under the microscope as to the naked eye. Leighton in this respect, therefore, forms an exception to other brecciated chondrites, if Cohen's statement in regard to the latter is accepted, for he states that the megascopically sharp-appearing boundaries of the differently colored areas of such meteorites disappear under the microscope.† Yet the difference in appearance of the two portions of Leighton as seen under the microscope is not sufficient to establish the existence of a true brecciated structure in the sense that it is certain that the mass was at one time broken up and recemented or that fragments of different origin are here seen cemented together. The appearance rather suggests that a dark-

* Jahrb. K. K. Geol. Reichsanstalt, Wien, 1885, xxxv, 172.

† Meteoritenkunde, Heft II. p. 63.

colored liquid has been infused into the mass and affected certain portions. This infusion appears to have taken place subsequent to the cooling of the original magma. The siliceous minerals seen under the microscope are chrysolite and bronzite, apparently in about equal proportions. They occur as chondri, as fragments of chondri and of crystals, and as more or less completely formed crystals. The chrysolite chondri tend to be of small size, circular in form and monosomatic. One such chondrus measures .45 mm. in one diameter and .52 mm. in the other. Its border is composed of a series of grains more or less circular in outline and .06 mm. in diameter. A series of parallel alternate rods of chrysolite and glass averaging .03 mm. in width fills the interior. All these and the border extinguish simultaneously. Some of the other chrysolite chondri are characterized by a porphyritic structure. All the chrysolite is highly fissured, as is characteristic of meteoritic chrysolite. The bronzite chondri are as a rule less regular in outline than the chrysolite chondri and vary greatly in size. The largest seen is nearly 3 mm. in diameter, though of irregular boundary. It is made up of minute parallel fibers of bronzite .0075 mm. in width and 2–3 mm. in length. Other chondri show eccentric-radiated, parallel or irregular arrangement of fibers. One conspicuous chondrus is of oval outline, 6 mm. in its longest diameter and is composed of seven fan-shaped rays of bronzite set in an opaque background. The rays radiate from a point near the circumference of the chondrus and widen as they pass toward the opposite periphery. Each ray is divided into two longitudinally and there is a more or less sharply marked border of bronzite. The chondrus as a whole has circular polarization. Another chondrus of somewhat rectangular outline is about half composed of well-crystallized bronzite and the remainder passes into a series of half-glassy fibers. Narrow black veins evidently subsequent in origin to the chondri cut through the sections. The nickel-iron occasionally exhibits a tendency to follow these veins. The nickel-iron and troilite grains are megascopically of amœba-like outlines and evidently formed subsequent to the chondri. The crust when seen in section on the darker portions of the meteorite appears as a black, opaque band about .4 mm. in width. Owing to the dark color of the interior the crust is not easily distinguished from it. It is certain, however, that it does not exhibit the zones usually characterizing the crust of chondritic meteorites. As none of the sections prepared for study showed crust bordering the light-colored portions, no study of this could be made.

A partial analysis of the meteorite was made by Mr. H. W. Nichols with results as follows:

$Si\ O_2$	35.69
$Al_2\ O_3$	1.03
$Cr_2\ O_3$	0.12
Ni O	1.04
Co O	0.08
Ca O	1.93
$Na_2\ O$	0.95
$K_2\ O$	0.47
P	0.40
S	2.11
Fe	10.48
Ni	1.59
Co	0.21
	56.10

The remaining 44% is almost wholly Fe O and Mg O in approximately equal proportions, with probably a little water and some minor ingredients. The composition is that usual to the chondritic meteorites.

QUINN CANYON.

This meteorite was found, according to Mr. Walter P. Jenney,* at the above locality in Nevada, in the latter part of August, 1908, by a prospector looking for borax. Mr. Jenney further states that the prospector cut off a few small pieces from the meteorite with a cold chisel and took them to Tonopah, Nevada, for identification. Soon after he sold out his interest in the find and left the country. The purchaser of the prospector's interest placed such information as he had in the hands of Mr. Jenney with a view to rediscovering the meteorite. As a very imperfect description of the locality where the meteorite was situated had been obtained from the original discoverer, it was necessary for him to make two trips to the region before the mass could be relocated. These trips, made by automobile, required 430 miles of travel. The place of find was in the foothills of the Quinn Canyon range of mountains, Nye County, Nevada. These mountains are marked on some maps as the Grant Mountains. The locality is 90 miles east from Tonopah, 18 miles north from the Mt. Diablo base line, and 100 miles west of the Utah boundary. The meteorite was found on the western slope of the range and on the northern slope of a low hill of andesite. The slope was a gentle one and the contour

* Mining & Scientific Press, Jan. 9, 1909, p. 93.

of the surrounding hills was such that the meteorite in falling may have come at a low angle from the west, north, or northeast. The area is treeless but bears a sparse growth of grass and sage brush. It is uninhabited except for a few sheep herders and occasional wandering prospectors. The meteorite was found with its flat side down and its arched side projecting above the ground. It lay with its longest dimensions in an east and west direction and was imbedded in the mantle of soil covering the hill to a depth of 10 or 12 inches. Mr. Jenney states that the contour of the surface of the ground had evidently resulted from extremely slow erosion and there was no indication that the meteorite had ever been buried deeper and exposed by the wearing away of the hillside. Under Mr. Jenney's direction a freight wagon drawn by a team of six horses and provided with a crew of three men, and with derrick and chain pulleys, went to Quinn Canyon and hauled the meteorite to Tonopah, the nearest railroad point. The round trip consumed eight days.

Through the generosity of Messrs. Stanley Field, R. T. Crane, Jr., Cyrus H. McCormick, and George F. Porter of the Board of Trustees of the Museum, the meteorite was acquired by this Museum in April, 1909. It was shipped from Tonopah under the direction of Mr. Jenney and reached the Museum in good condition. It is the largest specimen in the Museum collection and one of the large iron meteorites of the world.

In form the meteorite shows considerable shaping from its passage through the air and hence, as is typical with such meteorites, is a low cone. This form is due doubtless to the excessive action of the heat and erosion of atmospheric resistance about the periphery of the front side of the meteorite. Here the meteorite is worn away most rapidly and thus acquires a slope toward the center. Another effect of the atmospheric resistance is seen in the production of deep channelings, furrowings, pittings, and numerous cylindrical holes on the front side. All these, while very irregularly distributed, have a generally radial arrangement from the center outward. The outline of the meteorite in the direction of its greatest length is essentially oval though somewhat irregular. The contours may be seen by referring to Plates LVI–LVIII. The longest diameter of the oval is 47 inches; the diameter at right angles to this is 35 inches, and the circumference 132 inches. The height of the cone is 20 inches. The weight of the meteorite as determined by two careful weighings is 3,275 lbs. (1,450 kilog.). The front or conical side of the meteorite and the rear or basal side present very different appearances both in contour

and relief of the surface. The front side is highly corrugated by deep and irregular channelings, pittings, and furrowings. The rear side is relatively smooth but with broad, shallow pittings. The features of the front side of the meteorite while very irregular may be classed as knobs, furrows, large and small pits and cylindrical holes. Of these the knobs lie between irregularly coursing furrows which leave the metal standing out in prominences, ranging in size from that of a man's fist down. These knobs are especially noticeable toward the apex of the cone, so that this has none of the smoothness which is often observed in meteorites of this form. The furrows are very irregular in their course but in a general way may be said to radiate outward from the center. They are shallow and sinuous, with the ridges between them usually broad and rounded. An average width for the furrows is one-half inch (1 cm.). Interspersed with and interrupting the furrows are shallow, shell-shaped pits from 1 to 3 inches (2.5 to 7.5 cm.) in diameter. These are the small pits referred to. The large pits differ in shape and character from the small pits, since they penetrate deeply into the mass of the meteorite. The largest of these pits is a bowl-like depression about nine inches (23 cm.) in diameter and four inches (10 cm.) deep. On Plate LVII it may be seen near the base of the meteorite. The contour and surface of this pit are irregular but it is much the deepest and largest depression observed. Perhaps the most interesting feature in regard to it is the occurrence, spread over the bottom in two places covering about one square inch each, of a crust of black, magnetic iron oxide. This adheres very firmly to the metal which it covers so that it can only be removed by blows with a hammer and chisel. It is continuous as a broad patch in the two places where it occurs but the two patches, while situated near together, do not join. The thickness of one of these patches is about 2 mm., that of the other is much less at the thickest point and dwindles away to nothing. The surface of the thicker patch is rough and corrugated.

The cylindrical holes referred to occur irregularly over the surface, not being grouped or lineally arranged so far as can be determined. Of these 35 may be counted with orifices varying from one-fourth of an inch (5 mm.) to one and one-fourth inches (3 cm.) in diameter. The majority are about one inch (2.5 cm.) in diameter. They penetrate to various depths the deepest being two inches (5 cm.). Frequently the cavity within is larger and of somewhat different shape from the orifice. As a rule, though, it has an approximately cylindrical shape and is about the size of the orifice. Other shapes noted for the orifices

besides circular are oval, semicircular, kidney-shape and pear-shape. The direction of the cavity tends to be at right angles to the surface, but this varies also. Holes similar to these occur in many large iron meteorites, such as Chupaderos and Charcas, and are usually ascribed to a boring action of the air, or to the fusing out of troilite nodules. Their occurrence in the Quinn Canyon meteorite does not seem to throw any additional light on their origin. Their existence must be more or less responsible for the noise which accompanies the fall of a meteorite, for when a current of compressed air is directed against one of them a sharp, ear-piercing sound is produced. What the noise must be from this cause when the whole mass, highly heated, is advancing at an enormous velocity, is almost beyond comprehension.

Aside from these coarse features of relief of the surface, there are others of a more minute character. These may be designated as structure markings and lines of flow. The structure markings show the intimate crystal structure of the iron and are most abundant on the walls and at the bottom of cavities near the apex of the meteorite. They consist of groups of parallel ridges about 1.5 mm. apart, cross-hatched by shorter ridges at right angles. Small square pits about 1 mm. on a side are formed as a result. The long ridges are probably formed by tænite ribbons. Those at right angles are at irregular intervals, and probably mark the crossing of other bands. As a rule the groups of long ridges run in three directions at angles of 60° and often intersect to form triangles. The lines of flow as a rule cap the ridges of the meteorite and for the most part follow the crests but also at times cross them in a series of sinuous, more or less parallel lines. The metal is brighter along the lines of flow and in broad patches adjacent to them. They have the appearance therefore of a thin skin of metal which has fused and started to flow at various points. The thickness of this skin can hardly be more than 0.1 mm. The direction of flow is always away from the center of the meteorite, or in other words from the apex toward the base of the meteorite.

The pittings on the rear side may be divided into two classes as regards size and shape though all are probably similar in origin. The pittings of one class are large and circular or oval in outline. One of the circular pits is 4 inches (10 cm.) in diameter, and the largest oval pit has dimensions of 8 x 8 inches (20 x 13 cm.). Others of the large pittings have less regular shapes but all have sharp edges and do not merge into one another. The pittings of the other class are smaller, dot the surface pretty uniformly and average about one inch (2.5 cm.) in diameter. They show all variations of shape between

cavities of circular form and angular depressions between angular elevations. These angular elevations doubtless represent the octahedral structure of the meteorite. The fact that the octahedral structure is thus brought into relief indicates that this pitting is due to a slow process of weathering and solution which the meteorite has undergone since its arrival on the earth. The larger pits are all doubtless produced by a process of weathering and solution, but the cause of their size and shape is not clear to the writer. Pits of the same general nature though much larger and deeper characterize the Willamette meteorite and were referred by Ward,* to a weathering process without any theory as to details. The rear side of the Quinn Canyon meteorite was, as has been stated, immersed in the soil and this gave, probably, moisture which aided solution of the iron. Carbonate of lime in the form of a whitish, closely adhering deposit covered, when the meteorite arrived at the Museum, the portion which had been imbedded, about the sides but not to any extent on the bottom, that is, the flat surface. The larger pits contained a considerable deposit of hydrous iron oxide in the form of scales which could easily be pried off. The side of the meteorite which had not been imbedded showed no weathering.

In connection with his account of the finding of the meteorite, Mr. Jenney described the passage of a large meteor over the region February 1, 1894. This account he repeats and elaborates in a later article† and considers it highly probable that the Quinn Canyon meteorite fell at this time. While there seems nothing impossible in the view, it is also true that there seems no way of positively connecting the two occurrences. The decomposition seen on the imbedded portion of the meteorite might seem to have required a longer time than fourteen years for its production, but no definite means of measuring this is known. The slight depth to which the meteorite was imbedded in the soil shows that it must have reached the earth with a very low velocity, in fact, so low that it is difficult to conceive how so large a mass could have alighted so gently. The assumption of a path nearly tangential to the earth's surface and a direction of motion similar to that of the earth seems the only way of explaining so slight a vertical penetration.

In order to determine the character of the etching figures of the meteorite two small fragments, weighing 9 and 15 grams respectively, have been cut from it since its arrival at the Museum. The surface

*Proc. Rochester Acad. Sci., 1904, 4, 141–146.

†Am. Jour. Sci., 1909, 4, 28, 431–434.

of the iron was quite resistant and hence the cutting was performed with some difficulty. Beneath the surface the iron is relatively soft. The depth to which the hardening extends is small and unmarked by any change of structure that can be observed either on etched or

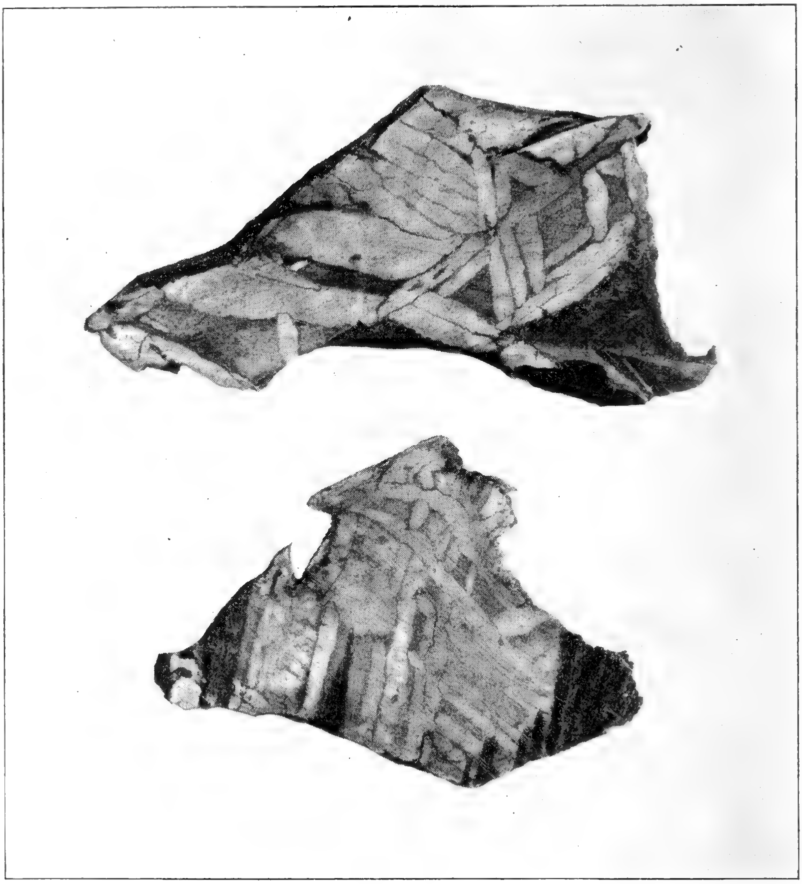

Fig 1. Etching figures of Quinn Canyon meteorite. ×2.

unetched sections. Mr. Jenney describes the meteorite as covered with a "thin, smooth skin of magnetic oxide" which he considered to have protected the mass from corrosion. It is true that the color of the surface of the meteorite is brownish-black as compared with the nickel-white color of the interior, and this surface color probably indicates superficial oxidation. The coating of oxide is, however, exceedingly thin. The interior of the iron is of nickel-white color

and polishes well. Etching is easily performed with dilute nitric acid, the figures coming out very quickly. In fact, they are dimly outlined on surfaces which have been simply polished. The figures seen on etching the fragments are shown enlarged in Fig. 1. They are octahedral in character with long, straight, swollen, and little grouped bands. The fields are few in number and subordinate. They vary in size and have the forms of triangles, rhombs, and parallelograms. They are filled with dark-gray plessite, much darker in color than the kamacite. This plessite may be quite uninterrupted or it may contain networks of tænite, seen over the whole field or only in portions of it. The kamacite of one of the fragments etched shows well-marked hatching, the lines running in three directions, two at right angles and one diagonally. The directions of these lines are as a rule different for the different bands, each band having its own system but in one group of bands 8 mm. wide but subdivided by little tongues of tænite into smaller bands about 1 mm. in width, the orientation of the hatching lines is the same throughout.

While one of the fragments exhibits hatched kamacite the other exhibits only spotted kamacite. The spots of the latter are about 1 mm. in diameter, and of uniform size. It is possible that the portion of the meteorite showing spotted kamacite was more highly heated and the hatched kamacite thus metamorphosed to spotted kamacite.

Analysis of the meteorite was made by H. W. Nichols from material obtained by boring with a $\frac{5}{16}$-inch drill to a depth of $2\frac{1}{2}$ inches. About 20 grams of material were thus obtained, varying in structure from continuous shavings an inch or more in length to fine metallic powder. The color of the material was iron-gray. The portions used for analysis were carefully sampled from the whole lot of borings. The analysis gave:

Fe	91.63
Ni	7.33
Co	0.73
Cu	tr.
S	0.00
P	0.20
Si	0.02
	99.91

The composition of the meteorite thus corresponds to that usual to the medium octahedrites. In addition to the components shown above careful search was also made for gold, platinum, or other rare metals. These were looked for in the following manner: A portion

of the carefully sampled borings weighing 5½ grams was dissolved in nitric acid. Although no residue was obtained, the solution was evaporated to dryness, ignited so as to convert the iron to sesquioxide, and an assay made by the crucible method. The charge used consisted of 50 grams litharge, 25 grams soda, 25 grams borax glass, 5 grams scouring sand, and 4½ grams argols. The lead button obtained weighed 22 grams. On cupelling this no residue was obtained.

A partial analysis was made of the crust of magnetic oxide described on page 171. Fragments of this were broken off by careful chiselling, and in this way .3396 grams were obtained. The material was evidently somewhat hydrous and more or less coated with carbonate of lime. It was dissolved by hydrochloric acid although acted on very slowly by that solvent. Determinations of ferrous and ferric iron in the solution gave:

		Calc. to 100	Theory for Magnetite
FeO	20.84	27.62	31
Fe_2O_3	54.60	72.38	69
	75.44	100	100

The remainder which was not determined quantitatively, was chiefly water, lime, CO_2, and silica. The proportions of ferrous and ferric oxide shown by the analysis leave little doubt that the mineral is magnetite and show that the oxidation which the surface of an iron meteorite undergoes in its passage through the air may produce this mineral.

COMPOSITION OF TÆNITE.

The composition of tænite, as is well known, varies between rather wide limits. As these limits do not seem as yet to have been determined by comparison of analyses, the writer has endeavored to collect all existing reliable analyses in order that such determination may be made. The compilation of analyses together with a calculation of the ratio of iron to nickel-cobalt-copper will be found below:

	Fe	Ni		Co	Cu	C	Total	Fe:Ni+Co+Cu
1	86.44	13.02		0.54	....	....	100.00	6.9 : 1
2	85.00	14 00		....	....	....	99.00	6.4 : 1
3	85.00	15.00		....	....	....	100.00	6.0 : 1
4	83.28	....	16 68	....	0.04	....	100.00	5.2 : 1
5	80.30	.....	19.60	....	....	....	99.90	4.1 : 1
6	74.78	24.32		0.33	....	0.50	99.93	3.2 : 1
7	73.10	23.63		2.10	....	1.17	100.00	3.0 : 1

	Fe	Ni	Co	Cu	C	Total	Fe:Ni+Co +Cu
8	73.0	27.00	....	....	....	100.00	2.8 : 1
9	72.12	27.73	0.02	....	0.12	100.00	2.7 : 1
10	71.29	26.73	1.68	....	0.30	100.00	2.6 : 1
11	70.14	29.74	....	....	....	99.88	2.5 : 1
12	69.30	29.73	0.60	....	0.37	100.00	2.4 : 1
13	68.13	30.85	0.69	0.33	....	100.00	2.2 : 1
14	65.54	32.87	1.59	....	....	100.00	2.0 : 1
15	65.39	33.20	1.41	....	....	100.00	2.0 : 1
16	65.26	34.34	0.40	....	....	100.00	2.0 : 1
17	63.55	34.65	1.01	0.30	0.49	100.00	1.9 : 1
18	63.04	35.53	1.43	....	tr.	100.00	1.8 : 1
19	61.89	36.95	0.36	....	0.80	100.00	1.7 : 1
20	61.87	..... 38.13	....	tr.	....	100.00	1.7 : 1
21	57.18	34.00	....	....	0.55	91.73	1.7 : 1
22	50.73	47.80	0.63	0.37	0.47	100.00	1.1 : 1

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2. Charcas. Meunier: Ann. Chim. et Phys., 1869 (4), xvii, 31. Particles mechanically isolated by their color.
3. Caille. Meunier: Ann. Chim. et Phys., 1869 (4), xvii, 32. Net-like web, isolated by means of dilute nitric acid.
4. Casas Grandes. Tassin: Proc. U. S. Nat. Mus., 1902, xxv, 73.
5. Kenton Co. Nichols: Pub. Field Col. Mus., 1902 Geol. Ser., i, 315. Thin, tin-white, elastic, magnetic plates, 4 mm. square, with finely ribbed surface.
6. Welland. Davison: Am. Jour. Sci., 1891 (3), xlii, 66. Mechanically isolated plates $\frac{1}{15}$–$\frac{1}{30}$ mm. thick, silver-white to bronze-yellow, flexible and elastic.
7. Staunton. Cohen and Weinschenk: Ann. Wien Naturhist Mus., 1891, vi, 146. Gray, relatively thick and brittle plates. Isolated by dilute HCl. Calculated to 100 after deducting schreibersite.
8. Cosby Creek. Smith: Comptes Rendu, 1881, xcii, 843. Little thin plates of white metallic color left after dissolving the iron in acid.
9. Canyon Diablo. Tassin: Smithsonian Misc. Coll., 1907, i, 212. Calculated to 100 after deducting 0.26% schreibersite.
10. Magura. Weinschenk: Ann. Wien Naturhist. Mus., 1889, iv, 97. Thin, tough, silver-white lamellæ soluble with difficulty in acids. Isolated by dilute HCl. Calculated to 100 after deduction of schreibersite.
11. Cranbourne. Flight: Phil. Trans. London, 1882, No. 171, 888. White, flexible, magnetic, triangular or rhombic mechanically isolated plates.
12. Misteca. Cohen: Ann. Wien Naturhist. Mus., 1892, vii, 152. Dull and brittle plates. Isolated by HCl. Calculated to 100 after deducting schreibersite.

13. Canyon Diablo. Florence: Am. Jour. Sci., 1895 (3), xlix, 105. Thin tin-white, flexible plates. Calculated to 100 after deduction of 3.60% schreibersite.
14. Wichita Co. Cohen and Weinschenk: Ann. Wien Naturhist. Mus., 1891, vi, 155. Isolated by dilute HCl. Calculated to 100 after deduction of schreibersite.
15. Chupaderos. Manteuffel: Ann. Wien Naturhist. Mus., 1892, vii, 150. Brittle, tin-white plates. Isolated by HCl. Calculated to 100 after deducting schreibersite.
16. Toluca. Cohen and Weinschenk: Ann. Wien Naturhist. Mus., 1891, vi, 137. Tin-white, flexible plates. Isolated by HCl. Calculated to 100 after deducting schreibersite.
17. Canyon Diablo. Fahrenhorst: Ann. Wien Naturhist. Mus., 1900, xv, 376. Thin, flexible plates partly appearing made up of many lamellæ, light-yellow or grayish. Schreibersite, 2.34% deducted.
18. Glorieta Mountain. Cohen and Weinschenk: Ann.Wien Naturhist. Mus., 1891, vi, 137. Tin-white. flexible, grouped plates. Isolated by HCl Calculated to 100 after deducting schreibersite.
19. Bischtübe. Cohen: Ann. Wien Naturhist. Mus., 1897, xii, 54. Large, flexible plates with included schreibersite. Isolated by HCl.
20. Penkarring Rock. Fletcher: Min. Mag., 1899, xii, 174. Thin, flexible plates. Analysis calculated to 100 after deducting 4.18% schreibersite.
21. Medwedewa. Berzelius: Pogg. Ann., 1833, xxxiii, 133. Analysis of skeleton material left behind after dissolving in HCl.
22. Beaconsfield. Sjöström: Monatsberichte Berlin Akad., 1897, 1041. Tin to silver-white, lustrous plates. Iron determined by difference.

The analyses, as will be observed, show variations of composition from Fe_7 Ni to Fe Ni. While this variation is a wide one it is evident that it is between certain limits, and that it would be incorrect to ascribe too indefinite a composition to tænite.

TIMES OF FALL OF METEORITES.

The following study has already been published in part by the author.* In the present paper the records are given in full and contributions to the subject by other authors are incorporated.

The times of fall of meteorites may be studied with reference to the year, month, day, and hour. The yearly falls should give evidence as to the frequency of the occurrence and exhibit periods if any occur. The falls by months should show the relation of meteorites to well-established star showers and the portion of the earth's orbit where meteorites are most frequently encountered. The falls by days should exhibit periodicity if any exists and variation in the uniformity of supply. Finally the hours of fall should give the direction of move-

*Am. Jour. Sci., 1910 (4), 29, 211–215.

ment of meteorites. Since new falls occur yearly, data for study of these points are obviously constantly on the increase. It is desirable, however, to make comparisons at intervals in order that any changes may be discerned. At the present time the admirable catalogues of Wülfing * and others, afford excellent means for the collection of such data. From these catalogues, with such additions and corrections as could be made from other sources, the writer has obtained record of 350 well authenticated meteorite falls of which the year and month are known, 327 of which the day is known, and 273 of which the time of day is known. In this number it has been sought not to include finds referred by residents of a locality to meteors which they had seen a year or more before, since the residents of most localities can, on the occasion of a meteorite find, recall a large meteor seen in that locality at some previous time. To connect this, however, without further reason with the meteorite found seems an unreliable method of procedure.

Considering the falls by years it is well known that previous to the nineteenth century little reliable record of meteorite falls is available. Single falls are known for the years 1492, 1668, 1715, 1723, 1751, 1766, 1773, 1785, 1787, 1790, 1794, 1795, and 1796, and two falls each for the years 1753, 1768, and 1798. For the early part of the nineteenth century the record is not very complete since during the that period the possibility of meteorite falls was yet much doubted. However, the record may as well begin with 1800. From that year to the present 331 falls may be accepted as well authenticated as to their month and year. During this period eleven years show no falls whatever. These years are, 1800, 1801, 1809, 1816, 1817, 1832, 1839, 1888, 1906, 1908, and 1909. Of these the years of the present decade will probably have falls to their credit after a time, since the record of falls usually lags several years behind their occurrence. The largest number of falls shown in any year during the period is 11 in 1868. The years 1865, 1877, and 1886 show 7 each. All the other years show from 1 to 6 falls each. The full record by years beginning with 1800 is as follows:

1800......	0	1806......	1	1812......	4	1818......	3
1801......	0	1807......	2	1813......	2	1819......	2
1802......	1	1808......	3	1814......	2	1820......	1
1803......	3	1809......	0	1815......	2	1821 .. .	1
1804......	2	1810......	2	1816......	0	1822.. ..	5
1805......	2	1811......	2	1817......	0	1823.. ...	2

* Die Meteoriten in Sammlungen, Tübingen, 1897.

1824	3	1846	4	1868	11	1890	6
1825	2	1847	2	1869	6	1891	2
1826	2	1848	3	1870	3	1892	3
1827	3	1849	1	1871	3	1893	4
1828	1	1850	2	1872	4	1894	3
1829	3	1851	2	1873	3	1895	3
1830	2	1852	4	1874	5	1896	4
1831	2	1853	3	1875	5	1897	6
1832	0	1854	1	1876	5	1898	3
1833	1	1855	4	1877	7	1899	5
1834	2	1856	3	1878	5	1900	3
1835	3	1857	6	1879	6	1901	3
1836	3	1858	4	1880	3	1902	5
1837	1	1859	5	1881	2	1903	3
1838	5	1860	5	1882	4	1904	1
1839	0	1861	3	1883	3	1905	3
1840	3	1862	2	1884	3	1906	0
1841	3	1863	6	1885	4	1907	1
1842	3	1864	3	1886	7	1908	0
1843	5	1865	7	1887	6	1909	0
1844	3	1866	6	1888	0		
1845	3	1867	2	1889	5		350

This record on the whole seems to indicate a comparatively uniform supply of meteorites, which is the more remarkable when one considers the various chances affecting the observation of their fall. The record seems to afford no evidence of cycles or periodicity which can be traced with certainty. Still the record of years is perhaps not as satisfactory for establishing conclusions in this regard as is that of other periods. As the writer has shown elsewhere* at least 900 meteorites probably reach the earth yearly. Of these only an average number of three is recorded, so that it is evident that a large allowance must be made for unrecorded ones. Yet it is fair to presume that those recorded are typical of the whole, because while opportunities for observation of meteorite falls have probably continually increased in number since 1800, the record by decades shows that the decade from 1860 to 1870 considerably exceeded in number of falls either of the two succeeding ones.

Passing from the falls by years, the falls by months may be examined. Such an examination should have an especial significance in showing the relations which meteorites may have to well-known star showers. Two of the best known of these showers occur in August and November. If meteorites are related to these, these months should show a larger fall than others. If meteorites are not related to these, no special increase for these months should be shown.

* Pop. Sci. Mon., 1904, pp. 351–354.

On compiling the results it is found that the months of May and June exhibit the greatest number of falls. The number for November falls below the average and that for August rises only slightly above. The evidence from this record is therefore that meteorites are not related to the best known star showers. It is fair to presume that the record by months will be somewhat influenced by the times that observers are most abroad. Most of the observations of meteorite falls are made in the northern hemisphere and in this hemisphere observers are more likely to be out of doors and hence more likely to observe the fall of meteorites in the summer than in the winter months. The record shows that as a whole the number of falls recorded *is* less for the winter than the summer months, yet the number of falls cannot be influenced by that alone since the high record for May and June drops to nearly half that number in July. Further the months of August, September and October are equally favorable as regards weather for observations of meteorite falls with those of April, May and June, yet the latter period much excels the former in number of falls. The excess of falls in May and June must, therefore, be due to other causes than favorable conditions of observation and seems to indicate that in the portion of the earth's orbit passed through in these months there is an unusual number of meteorites. The full table for the different months is as follows:

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
25	24	22	32	44	45	23	36	30	24	24	21=350

This record is shown graphically in the accompanying diagram, Fig. 2.

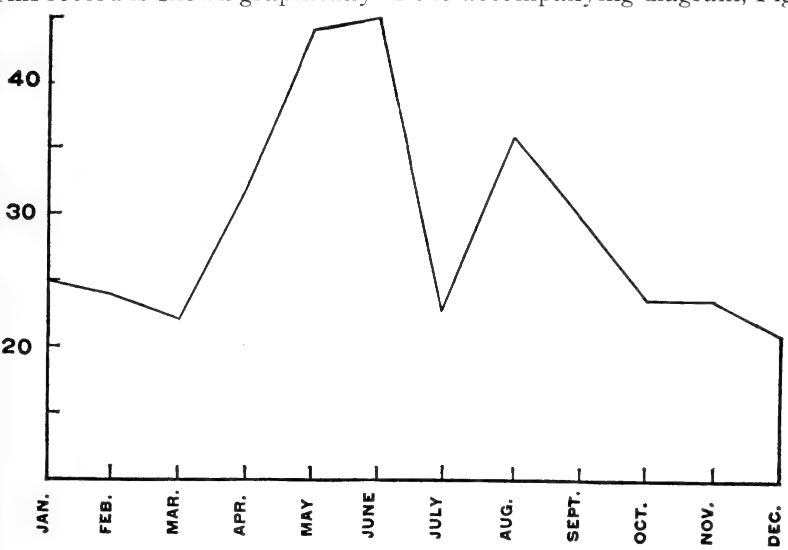


Fig. 2. Curve of meteorite falls by months.

Comparison of the falls of meteorites by months as here given with those of falling stars and fireballs as given by W. H. Pickering* shows a marked difference of distribution. According to Pickering's list the falling stars and fireballs are much more uniformly distributed through the year than are meteorites and the periods of greatest number of meteoric falls are from July to November. In May and June their number is at its minimum. Hence the record seems to show a difference in character between meteors and meteorites and furnishes *per se* a ground for questioning the gradation that has been supposed to exist between meteors and meteorites.

Tabulation of the falls by days of the year seems to show little of significance. The largest number of falls for any one day is 5 on October 13, and this is a month when the total number of falls is not large. Four days show 4 falls each and 158, or nearly half the total number, no falls at all. The days without falls seem to be scattered indiscriminately through the year, without marked grouping or arrangement. The days showing falls aside from those mentioned, have from one to three falls each without any marked grouping that is apparent. Such a record seems also to indicate that to refer a meteorite falling on the day of a star shower to such showers is unsafe practice especially if the observations are not sufficient to assign the two to the same radiant. The meteorite falls are so uniformly distributed throughout the year that the two occurrences might easily be coincident without being otherwise related. The full record of the falls by days is as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	2	..	..	1	1	..	1	3	..	2	..	1
2		1	..	..	1	2	..	1	1	..	..	2
3	2	2	..	1	..	3	..	..	1	2	..	..
4		..	1	1	..	2	2	1	1	..	..	1
5		..	..	1	1	..	..	4	4	2	1	1
6		..	2	2	..	2	..	..	1	1	..	1
7		..	..	2	..	2	..	2	2	1	..	1
8	1	..	..	..	3	..	1	1	..	1	..	..
9		1	..	2	2	2	..	..	2	..	..	1
10		3	..	3	1	..	1	2	1	..	1	1
11		..	..	1	2	1	1	3	..	1	1	..
12	1	2	3	1	1	4	1	1	..	..	2	..
13		2	..	2	2	2	..	1	3	5	..	3
14		..	..	..	3	2	3	2	1	1	..	1
15	1	2	1	2	1	2	1	..	1	..	2	..
16	1	3	1	..	..	2	..	2	1	..	1	..

* Popular Astronomy, 1909, 17, 277.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
17		..	1	1	3	1	2	..	..	..	1	..
18		3	..	1	..	2	1	1	..	1	..	..
19	2	1	2	1	3	1	..	..	1	..	2	1
20	1	..	1	1	3	2	1	..	..	..	1	..
21	1	..	..	..	1	2	..	..	1	2	..	1
22		..	1	..	3	1	1	1	3	1	..	2
23	3	..	..	..	1	..	1	..	1	..	1	..
24		..	1	1	2	..	2	..	..	1	1	..
25	2	1	3	..	1	1	1	2	..	..	1	1
26		..	..	3	2	1	..	..	1	1	1	..
27	1	..	1	1	2	..	1	..	1	..	3	2
28	1	1	2	..	1	3	..	..	1	..	..	..
29	1	1	..	1	..	1	..	3	..	1	..	..
30	1	..	..	..	1	1	..	1	..	..	4	..
31	2	..	1	..	..	..	..	1	..	1	..	..
	23	23	21	29	41	42	21	32	28	24	23	20 = 327

Of all times of fall of meteorites the most satisfactory for study are probably the hours of fall, since the ratio of number of falls to number of hours is larger than to days, months, or years. As is well known, the hours of fall show the direction of movement of meteorites, since (with a few minor possible obvious exceptions) meteorites falling from noon to midnight, or afternoon falls, as they may be called, must be moving in the same direction as the earth; while those falling between midnight and noon, or forenoon falls, are moving in a direction opposite to that of the earth or else at a speed so slow that they are overtaken by it. While the hour of fall is not known of as many meteorites as is the year and month, yet of 273 sufficiently satisfactory records are available. Of these 273 falls 184 occurred in the time from noon to midnight, and 89 from midnight to noon. The record in full is as follows, the total number being less by seven than that recorded for forenoon and afternoon, since of these seven the hour is not known:

Hours	12	1	2	3	4	5	6	7	8	9	10	11	Total
A. M.	1	2	3	2	6	7	7	18	12	10	9	12	= 89
P. M.	24	13	19	33	21	15	11	8	16	7	9	3	= 176

As in the case of the months and the years, it is quite likely that here also considerable allowance should be made for conditions of observation. It is reasonable to expect that the number of falls recorded in the early morning hours would be less than that for other times, since mankind is generally asleep then. That some such allowance must be made is indicated by the records, for the number of falls from midnight to 6 A. M. is only 21, while from 6 A. M. to noon it is 68;

from noon to 6 P. M. 124, and from 6 P. M. to midnight 60. Hence it seems probable that some of the diminution in the number of falls is due to lack of observers, although Newton* seemed to conclude from studies of the orbits of the morning falls that lack of observers had little to do with their scarcity. Lack of meteorites during morning hours may also be due in part, as Newton suggested, to the fact that such as have retrograde motion are more likely to be burned up by the greater velocity with which they strike the earth's atmosphere. This increase in velocity is not so great as might be supposed since Lowell has shown † that it cannot exceed 2.66 miles per second. Yet Pickering ‡ thinks it is sufficient to destroy all that have retrograde motion, or that the velocity of such as have retrograde motion would be higher than any that has yet been recognized. It is not clear how such an increase would be very apparent if this increase at most is only 2.66 miles per second. On account of the above probabilities Pickering is of the opinion that most if not all of the meteorites which fall in the morning hours are moving at so slow a speed that they are overtaken by the earth. Schiaparelli, who gave the matter much study and to whom we are indebted for extensive researches in the relations between comets and meteors, concluded that many meteorites had hyperbolic velocities and hence must come from the world of fixed stars rather than from comets or the solar system. || Newton assigned to the stone of Stannern a velocity of 45 miles per second, and concluded that most meteorites are allied to short period comets in their velocities.§ Pickering ¶ regards it doubtful whether any stony meteorites move fast enough to be accredited with cometary velocities.

The hourly falls of the writer's table are shown plotted in Plate LIX. It will be observed that the peak of the falls occurs at 3 P.M. Pickering has shown ** that other things being equal the greatest number of meteorites would be expected when the Earth's quit is highest above the horizon and that this occurs for the northern hemisphere, longitude 90°, at 3 P. M., May 6. This high point agrees with that of the greatest number of meteorites, for they are most numerous in May

* Am. Jour. Sci., 1888, 3, 36, 10.

† Science. N. S., 1909, 30, 339.

‡ Popular Astronomy, 1910, 18, 264.

|| Entwurf einer Astronomischen Theorie der Sternschnuppen. Boguslawski's translation, 1871, p. 228.

§ Am. Jour. Sci., 1888, 3, 36, 11, and 13.

¶ Popular Astronomy, 1910, 18, 276.

** *Op. cit.*, p. 272.

and at 3 P. M. It may also be remarked that the writer has shown that meteorites are most numerous in mountain regions,* so that the high points seem in every respect to be the most successful in acquiring meteorites.

It would be possible from the writer's data to compare falls at different intervals and for different periods in order to determine whether various periods agree in times of fall. Such examination of the records as the writer has made shows that the distribution of the falls is about the same in all the periods. In order to secure independent testimony on this point the writer's results may be compared with those of Haidinger, who in 1867 † gave the hours of 178 meteorite falls. His table was as follows:

	12	1	2	3	4	5	6	7	8	9	10	11		
A. M.	1	3	2	2	4	5	4	13	5	7	5	23	=	74
P. M.	9	11	11	19	18	9	6	10	5	1	0	5	=	104

On examination of these falls by name, however, it appears that some are assigned times of fall which later investigation has shown to be unreliable, as is true of the meteorite of Mincy for example and others listed are not now recognized as meteoritic. For these reasons about 40 falls must be eliminated from Haidinger's list. Omitting these the result is as follows:

	12	1	2	3	4	5	6	7	8	9	10	11		
A. M.	1	1	1	2	3	3	4	10	5	5	5	17	=	57
P. M.	7	9	9	16	15	7	5	7	3	0	0	3	=	81

An excess of afternoon over forenoon falls is seen here as in the writer's list, although the proportion is less, it being nearly 2 : 1 in the writer's list and 1.4 : 1 in Haidinger's list. More significant perhaps is the fact that both lists show an excess of falls at 7 A. M., 11 A. M., and 3 P. M.

On the whole the study of the times of fall of meteorites in the manner here adopted seems to show (1) that they differ considerably from meteors in times of fall, (2) that they are not noticeably related to any of the well known star showers and (3) that the rate of their supply to the earth is remarkably uniform.

LIST OF METEORITES OF THE UNITED STATES OF AMERICA BY STATES.

The following list comprises the meteorites of the United States as at present known, grouped by States. Great care has been taken in

* Pop. Sci. Mon., 1904, p. 352.

† Sitzb. Kais. Akad. der Wiss. Wien. Bd. 55.

the preparation of this list to include only meteorites which may properly be regarded as separate falls, and on the other hand to include all that should be so regarded. It is thought that such a list will be useful for reference and tend toward uniformity of nomenclature. The classification of each meteorite according to Brezina's system, so far as known, is shown by abbreviations, the full forms of which are as follows:

Cc.	Stone, Spherulitic chondrite.
Cca.	Stone, Veined spherulitic chondrite.
Ccb.	Stone. Breccia-like spherulitic chondrite.
Cco.	Stone, Ornans spherulitic chondrite.
Cck.	Stone, Crystalline spherulitic chondrite.
Cg.	Stone, Gray chondrite.
Cga.	Stone, Veined gray chondrite.
Cgb.	Stone, Breccia-like gray chondrite.
Chla.	Stone, Veined chladnite.
Cho.	Stone, Howarditic chondrite.
Ci.	Stone, Intermediate chondrite.
Cia.	Stone, Veined intermediate chondrite.
Cib.	Stone, Breccia-like intermediate chondrite.
Ck.	Stone, Crystalline condrite.
Cka.	Stone, Veined crystalline chondrite.
Ckb.	Stone, Breccia-like crystalline chondrite.
Cs.	Stone, Black chondrite.
Csa.	Stone, Veined black chondrite.
Csb.	Stone, Breccia-like black chondrite.
Cw.	Stone, White chondrite.
Cwa.	Stone, Veined white chondrite.
Cwb.	Stone, Breccia-like white chondrite
D.	Iron, Ataxite.
Db.	Iron, Babb's Mill ataxite.
Dc.	Iron, Cape ataxite.
Dl.	Iron, Linville ataxite.
Dn.	Iron, Nedagolla ataxite.
Dr.	Iron, Rafruti ataxite.
Ds.	Iron, Siratik ataxite.
Dsh.	Iron, Shingle Springs ataxite.
Dt.	Iron, Tucson ataxite.
H.	Iron, Hexahedrite.
Ha.	Iron, Granular hexahedrite.
Hb.	Iron, Breccia-like hexahedrite.
Ho.	Stone, Howardite.
Kc.	Stone, Carbonaceous, spherulitic chondrite.
M.	Iron-stone, Mesosiderite.
Mg.	Iron-stone, Grahamite.
O.	Iron, Octahedrite.
Of.	Iron, Fine octahedrite.

Off.	Iron, Finest octahedrite.
Offbp.	Iron, Breccia-like finest octahedrite.
Og.	Iron, Coarse octahedrite.
Ogg.	Iron, Coarsest octahedrite.
Oh.	Iron, Hammond octahedrite.
Om.	Iron, Medium octahedrite.
P.	Iron-stone, Pallasite.
Pi.	Iron-stone, Imilac pallasite.
Pk.	Iron-stone, Krasnojarsk pallasite.
Pr.	Iron-stone, Rokicky pallasite.

LIST OF METEORITES BY STATES

ALABAMA.

Auburn, Lee Co., H. 32° 37′ N. 85° 32′ W., found 1867.
Chulafinnee, Cleburne Co., Om. 33° 35′ N. 85° 42′ W., found 1873.
Danville, Morgan Co., Cga. 34° 24′ N. 87° 5′ W., fell Nov. 27, 1868.
Desotoville, Choctaw Co., H. 32° 13′ N. 88° 10′ W., found 1859.
Felix, Perry Co., Kc. 32° 33′ N. 87° 12′ W., fell May 15, 1900.
Frankfort, Franklin Co., Ho. 34° 30′ N. 87° 52′ W., fell Dec. 5, 1868.
Leighton, Colbert Co., Cgb. 34° 40′ N. 87° 35′ W., fell Jan. 12, 1907.
Limestone Creek, Monroe Co., Dc. 31° 34′ N. 87° 30′ W., found 1834.
Selma, Dallas Co., Cc. 32° 25′ N. 87° W., found 1906.
Summit, Blount Co., Ha. 34° 13′ N. 86° 30′ W., found 1890.
Walker County, H. 33° 50′ N. 87° 15′ W., found 1832.
Stones, 5; irons 6; total, 11. Observed falls, 4.

ARKANSAS.

Joe Wright Mountain, Independence Co., Om. 35° 43′ N. 91° 27′ W., found 1884.
Cabin Creek, Johnson Co., Om., 35° 24′ N. 93° 17′ W., fell March 27, 1886.
Stones, 0; irons 2; total, 2. Observed falls, 1.

ARIZONA.

Canyon Diablo, Coconino Co., Og. 35° 10′ N. 111° 7′ W., found 1891.
Coon Butte, Coconino Co., Cib. 35° 10′ N. 111° 7′ W., found 1906.
Tucson, Pima Co., Dt. 32° 12′ N. 110° 35′ W., found 1851.
Weaver, Maricopa Co., Dt. 33° 58′ N 112° 35′ W., found 1898.
Stones, 1; irons 3; total 4. Observed falls. 0.

CALIFORNIA.

Canyon City, Trinity Co., Og. 40° 35′ N. 123° 5′ W., found 1875.
Ivanpah, San Bernardino Co., Om. 35° 30′ N. 115° 28′ W., found 1880.
Oroville, Butte Co., Om. 39° 18′ N. 122° 38′ W., found 1893.
San Emigdio Range, San Bernardino Co., Cc., found 1887.
Shingle Springs, El Dorado Co., Dsh. 38° 43′ N. 120° 53′ W., found 1869.
Surprise Springs, San Bernardino Co., Om. 34° 12′ N. 115° 54′ W., found, 1899.
Stones, 1; irons, 5; total, 6. Observed falls, 0.

COLORADO.

Bear Creek, Jefferson Co., Of. 39° 38′ N. 105° 16′ W., found 1866.
Franceville, El Paso Co., Om. 38° 48′ N. 104° 35′ W., found 1890.
Guffey, Park Co., Dr 38° 45′ N. 105° 30′ W., found 1907.
Russel Gulch, Gilpin Co., Of. 39° 47′ N. 105° 31′ W., found 1863.
Ute Pass, Summit Co., Ogg. 39° 48′ N. 106° 10′ W., found 1894.
Stones, 0; irons, 5; total, 5. Observed falls, 0.

CONNECTICUT.

Weston, Fairfield Co., Ccb. 41° 13′ N. 73° 27′ W., fell Dec. 14, 1807.
Stones, 1; Irons, 0; total, 1. Observed falls, 1.

GEORGIA

Canton, Cherokee Co., Ogg. 34° 12′ N. 84° 30′ W., found 1894.
Dalton, Whitfield Co., Om. 34° 59′ N. 84° 54′ W., found 1877.
Forsyth, Monroe Co., Cwa. 33° 3′ N. 83° 56′ W., fell May 8, 1829.
Hollands Store, Chattooga Co., Ha. 34° 22′ N. 85° 26′ W., found 1887.
Locust Grove, Henry Co., Ds. 33° 20′ N. 84° 8′ W., found 1857.
Losttown Creek, Cherokee Co., Om. 34° 10′ N. 84° 32′ W., found 1868.
Lumpkin, Stewart Co., Cck. 31° 54′ N. 84° 57′ W., fell Oct. 6, 1869.
Pickens County, Cck. 34° 30′ N. 84° 28′ W., found 1908.
Putnam County, Of. 33° 16′ N. 83° 25′ W., found 1839.
Thomson, McDuffie Co., Cga. 33° 23′ N. 82° 30′ W., fell Oct. 15. 1888.
Union County, Ogg. 34° 56′ N. 83° 58′ W., found 1853.
Stones, 4; irons, 7; total, 11. Observed falls, 3.

IDAHO.

Hayden Creek, Lemhi Co., Om. 45° 0′ N. 113° 45′ W., found 1895.
Stones, 0; irons, 1; total, 1. Observed falls, 0.

INDIANA.

Harrison County, Cho. 38° 12′ N. 86° 8′ W., fell March 28, 1859.
Kokomo, Howard Co., Dc. 40° 34′ N. 86° 2′ W., found 1862.
Plymouth, Marshall Co., Om. 41° 20′ N. 86° 18′ W., found 1893.
Rochester, Fulton Co., Cc. 41° 5′ N. 86° 13′ W., fell Dec. 21, 1876.
Rushville, Rush Co., Cg. 39° 22′ N. 85° 3′ W., found 1866.
South Bend, St. Joseph Co., Pi. 41° 40′ N. 86° 15′ W., found 1893.
Stones, 3; iron-stones, 1; irons, 2; total, 6. Observed falls, 2.

IOWA.

Estherville, Emmet Co., M. 43° 24′ N. 94° 50′ W., fell May 10, 1879.
Forest City, Winnebago Co., Ccb. 43° 17′ N. 93° 38′ W., fell May 2, 1890.
Homestead, Iowa Co., Cgb. 41° 39′ N. 91° 32′ W., fell Feb. 12, 1875.
Marion, Linn Co., Cwa. 41° 57′ N. 91° 34′ W., fell Feb. 25, 1847.
Stones, 3; iron-stones, 1; irons, 0; total, 4. Observed falls, 4.

KANSAS.

Admire, Lyon Co., Pr. 33° 0′ N. 96° 5′ W., found 1891.
Brenham, Kiowa Co., Pk. 37° 38′ N. 99° 13′ W., found 1885.
Elm Creek, Lyon Co., Cco. 38° 40′ N. 96° 5′ W., found 1906.

Farmington, Washington Co., Csa. 39° 48′ N. 97° 5′ W., fell June 25, 1890.
Jerome, Gove Co., Cck. 38° 47′ N. 100° 14′ W., fell Apr. 10, 1894.
Long Island, Phillips Co., Ck. 39° 56′ N. 99° 34′ W., found 1891.
Modoc, Scott Co., Cga. 38° 30′ N. 100° 55′ W., fell Sept 2, 1905.
Ness County, Cib. 38° 30′ N. 99° 37′ W., found 1897.
Oakley, Logan Co., Ck. 38° 55′ N. 101° 0′ W., found 1895.
Ottawa, Franklin Co., Cho. 38° 37′ N. 95° 18′ W., fell Apr. 9, 1896.
Prairie Dog Creek, Decatur Co., Cck. 39° 42′ N. 100° 24′ W., found 1893.
Saline, Sheridan Co., Cck. 39° 22′ N. 100° 27′ W., fell Nov. 15, 1898.
Scott, Scott Co., 38° 30′ N. 100° 55′ W., found 1905.
Tonganoxie, Leavenworth Co., Om. 39° 8′ N. 95° 7′ W., found 1886.
Waconda, Mitchell Co., Ccb. 39° 20′ N. 98° 10′ W., found 1873.
Stones, 12; iron-stones, 2; irons, 1; total 15. Observed falls, 5.

KENTUCKY.

Bath Furnace, Bath Co., Cia. 38° 2′ N. 83° 37′ W., fell Nov. 15, 1902.
Casey County, Og. 37° 20′ N. 84° 55′ W., found 1877.
Cynthiana, Harrison Co., Cg. 38° 24′ N. 84° 16′ W., fell Jan. 23, 1877.
Eagle Station, Carroll Co., Pr. 38° 37′ N. 85° 0′ W., found 1880.
Frankfort, Franklin Co., Om. 38° 7′ N. 84° 57′ W., found 1866.
Kenton County, Om. 38° 40′ N. 84° 29′ W., found 1889.
La Grange, Oldham Co., Of. 38° 37′ N. 85° 25′ W., found 1860.
Marshall County, Om. 36° 50′ N. 88° 17′ W., found 1860.
Mount Vernon, Christian Co., Pk. 36° 50′ N. 87° 28′ W., found 1868.
Nelson County, Ogg. 37° 48′ N. 85° 27′ W., found 1860.
Salt River, Bullitt Co., Off. 37° 56′ N. 85° 54′ W., found 1850.
Scottsville, Allen Co., H. 36° 45′ N. 86° 10′ W., found 1867.
Smithland, Livingston Co., Db. 37° 18′ N. 88° 17′ W., found 1839.
Williamstown, Grant Co., Om. 38° 35′ N. 84° 30′ W., found 1892.
Stones, 2; iron-stones, 2; irons, 10; total, 14. Observed falls, 2.

MAINE.

Andover, Oxford Co., Cc. 44° 36′ N. 70° 47′ W., fell Aug. 5, 1898.
Castine, Hancock Co., Cwa. 44° 24′ N. 68° 48′ W., fell May 20, 1848.
Nobleborough, Lincoln Co., Ho. 44° 4′ N. 69° 28′ W., fell Aug. 7, 1823.
Searsmont, Waldo Co., Cc. 44° 22′ N. 69° 12′ W., fell May 21, 1871.
Stones, 4; irons, 0; total, 4. Observed falls, 4.

MARYLAND.

Emmitsburg, Frederick Co., Om. 39° 43′ N. 77° 20′ W., found 1854.
Lonaconing, Allegheny Co., Og. 39° 28′ N. 79° 2′ W., found 1888.
Nanjemoy, Charles Co., Cc. 38° 25′ N. 77° 12′ W., fell Feb. 10, 1825.
Stones, 1; irons, 2; total, 3. Observed falls, 1.

MICHIGAN.

Allegan, Allegan Co., Cco. 42° 34′ N. 85° 52′ W., fell July 10, 1899.
Grand Rapids, Kent Co., Of. 42° 59′ N. 85° 42′ W., found 1883.
Reed City, Osceola Co., Oh. 43° 53′ N. 85° 32′ W., found 1895.
Stones, 1; irons, 2; total, 3. Observed falls, 1.

MINNESOTA

Arlington, Sibley Co., Om. 44° 30′ N. 93° 56′ W., found 1894.
Fisher, Polk Co., Cia. 47° 48′ N. 96° 49′ W., fell April 9, 1894.
Stones, 1; irons, 1; total, 2. Observed falls, 1.

MISSOURI.

Billings, Christian Co., Om. 37° 5′ N. 93° 28′ W., found 1903.
Butler, Bates Co., Off. 38° 18′ N. 94° 25′ W., found 1874.
Cape Girardeau, Cape Girardeau Co., Cc. 37° 13′ N. 89° 32′ W., fell Aug. 14, 1846.
Central Missouri, Ogg. Central portion of state, found 1855.
Little Piney, Pulaski Co., Cc. 37° 55′ N. 92° 5′ W., fell Feb. 13, 1839.
Mincy, Taney Co., M. 36° 35′ N. 93° 7′ W., found 1856.
Saint Francois County, Og. 37° 55′ N. 90° 36′ W., found 1863.
Saint Genevieve County, Of. 37° 47′ N. 90° 22′ W., found 1888.
Warrenton, Warren Co., Cco. 38° 44′ N. 91° 12′ W., fell Jan. 3, 1877.
Stones, 3; iron-stones, 1; irons, 5; total, 9. Observed falls, 3.

MONTANA.

Illlinois Gulch, Deer Lodge Co., Dn. 46° 39′ N. 112° 32′ W., fell 1897.
Stones, 0; irons, 1; total, 1. Observed falls, 0.

NEBRASKA.

Ainsworth, Brown Co., Om. 42° 30′ N. 99° 50′ W., found 1907.
Mariaville, Rock Co., Iron, 42° 45′ N. 99° 25′ W., desc. 1897.
Ponca Creek, Boyd Co., Ogg., desc. 1863.
Redwillow County, Iron, desc., 1897.
York, York Co., Iron, 40° 52′ N. 97° 33′ W., found 1878.
Stones, 0; irons, 5; total, 5. Observed falls, 0.

NEVADA.

Quinn Canyon, Nye Co., Om. 38° 30′ N. 115° 20′ W., found 1908.
Stones, 0; irons, 1; total, 1. Observed falls, 0.

NEW JERSEY.

Deal, Monmouth Co., Ci. 40° 14′ N. 74° 1′ W., fell Aug. 14, 1829.
Stones, 1; irons, 0; total, 1. Observed falls, 1.

NEW MEXICO.

Costilla, Taos Co., Om. 36° 50′ N. 105° 13′ W., found 1881.
El Capitan, Lincoln Co., Om. 33° 30′ N. 105° 30′ W., found 1893.
Glorieta Mountain, Santa Fe Co., Om. 35° 22′ N. 105° 50′ W., found 1884.
Luis Lopez, Socorro Co., Om. 34° 0′ N. 107° 0′ W., found 1896.
Oscuro Mountains, Socorro Co., Og. 33° 45′ N. 107° 20′ W., found 1895.
Sacramento Mountains, Otero Co., Om. 32° 32′ N. 105° 20′ W., found 1896.
Stones, 0; irons, 6; total 6. Observed falls, 0.

NEW YORK.

Bethlehem, Albany Co., Cck. 42° 6′ N. 73° 47′ W., fell Aug. 11, 1859.
Burlington, Otsego Co., Om. 42° 40′ N. 75° 8′ W., found 1819.

Cambria, Niagara Co,. Of. 43° 13′ N. 78° 45′ W., found 1818.
Seneca Falls, Seneca Co., Om. 42° 57′ N. 76° 58′ W., found 1850.
Tomhannock Creek, Rensselaer Co., Cgb. 42° 52′ N. 73° 36′ W., found 1863.
Stones, 2; irons, 3; total, 5. Observed falls, 1.

NORTH CAROLINA.

Asheville, Buncombe Co., Om. 35° 36′ N. 82° 31′ W., desc. 1839.
Black Mountain, Buncombe Co., Og. 35° 53′ N. 80° 3′ W., found 1839.
Bridgewater, Burke Co., Of. 35° 45′ N. 81° 53′ W., found 1890.
Castalia, Nash Co., Cgb. 36° 4′ N. 78° 4′ W., fell May 14, 1874.
Colfax, Rutherford Co., Om. 35° 18′ N. 81° 45′ W., found 1880.
Cross Roads, Wilson Co., Cg. 35° 38′ N. 78° 7′ W., fell May 24, 1892.
Deep Springs, Rockingham Co., Db. 36° 20′ N. 79° 35′ W., found 1846.
Duel Hill, Madison Co., Og. 35° 51′ N. 82° 44′ W., found 1873.
Ferguson, Haywood Co., Stone, 35° 36′ N. 83° 0′ W., fell July 18, 1889.
Flows, Cabarrus Co., Cga. 35° 18′ N. 80° 33′ W., fell Oct. 31, 1849.
Forsyth County, Dn. 36° 8′ N. 80° 20′ W., found 1895.
Guilford County, Om. 36° 4′ N. 79° 48′ W., desc. 1822.
Hendersonville, Henderson Co., Cc. 35° 19′ N. 82° 28′ W., found 1901.
Jewel Hill, Madison Co., Of. 35° 49′ N. 82° 45′ W., found 1854.
Lick Creek, Davidson Co., H. 35° 40′ N. 80° 12′ W., found 1879.
Linville, Burke Co., Dl. 35° 48′ N. 81° 55′ W., found 1882.
Murphy, Cherokee Co., H. 35° 6′ N. 84° 2′ W., found 1899.
Persimmon Creek, Cherokee Co., Offbp. 35° 3′ N. 84° 4′ W., found 1893.
Smith's Mountain, Rockingham Co., Of. 36° 32′ N. 79° 58′ W., found 1863.
Stones, 5; irons, 14; total, 19. Observed falls, 4.

NORTH DAKOTA.

Jamestown, Stutsman Co., Of 46° 42′ N. 98° 34′ W., found 1885.
Niagara, Grand Forks Co., Og. 47° 58′ N. 97° 52′ W., found 1879.
Stones, 0; irons, 2; total, 2. Observed falls, 0.

OHIO.

Anderson Township, Hamilton Co., P. 39° 10′ N. 84° 18′ W., desc. 1884.
Cincinnati, Hamilton Co., Ds. 39° 7′ N. 84° 29′ W., desc 1898.
Hopewell Mounds, Ross Co., Om. 39° 10′ N. 83° 20′ W., desc. 1902.
New Concord, Guernsey Co., Cia. 39° 58′ N. 81° 44′ W., fell May 1, 1860.
Pricetown, Highland Co., Cw. 33° 11′ N. 83° 44′ W., fell Feb. 13, 1893.
Wooster, Wayne Co., Om. 40° 48′ N. 81° 58′ W , found 1858.
Stones, 2; ironstones, 1; irons, 3; total, 6. Observed falls, 2.

OREGON.

Port Orford, Curry Co., P. 42° 46′ N. 124° 28′ W., found 1859.
Willamette, Clackamas Co , Om. 45° 22′ N. 122° 35′ W., found 1902.
Stones, 0; ironstones, 1; irons, 1; total, 2. Observed falls, 0.

PENNSYLVANIA.

Bald Eagle, Lycoming Co., Om. 41° 12′ N. 77° 5′ W., found 1891.
Mount Joy, Adams Co., Ogg. 39° 44′ N. 77° 20′ W., found 1887.

Pittsburg, Allegheny Co., Ogg. 40° 27′ N. 79° 57′ W., found 1850.
Shrewsbury, York Co., Om. 39° 45′ N. 76° 35′ W., found 1907.
Stones, 0; irons, 4; total, 4. Observed falls, 0.

SOUTH CAROLINA.

Bishopville, Sumter Co., Chla. 34° 12′ N. 80° 18′ W., fell Mar. 25, 1843.
Chesterville, Chester Co., Dn. 34° 42′ N. 81° 15′ W., found 1847.
Laurens County, Off. 34° 30′ N. 82° 14′ W., found 1857.
Lexington County, Og. 33° 57′ N. 81° 18′ W., found 1880.
Ruff's Mountain, Newberry Co., Om. 34° 15′ N. 81° 21′ W., found 1844.
Stones, 1; irons, 4; total, 5. Observed falls, 1.

SOUTH DAKOTA.

Bath, Brown Co., Ccb. 45° 27′ N. 98° 19′ W., fell Aug. 29, 1892.
Fort Pierre, Stanley Co., Om. 44° 23′ N. 100° 46′ W . found 1856.
Stones, 1; irons, 1; total, 2. Observed falls, 1.

TENNESSEE.

Babb's Mill, Greene Co., Db. 36° 18′ N. 82° 54′ W., found 1842.
Carthage, Smith Co., Om. 36° 20′ N. 85° 56′ W.. found 1844.
Charlotte, Dickson Co., Of. 36° 13′ N. 87° 20′ W., fell Aug. 1, 1835.
Cleveland, Bradley Co., Om. 35° 8′ N. 84° 53′ W., found 1860.
Coopertown, Robertson Co., Om. 36° 25′ N. 87° 0′ W., found 1860.
Cosby Creek, Cocke Co., Og. 35° 48′ N. 83° 15′ W., found 1837.
Crab Orchard, Cumberland Co., Mg. 35° 53′ N. 84° 48′ W., found 1887.
Drake Creek, Sumner Co., Cwa. 36° 18′ N. 86° 34′ W., fell May 9, 1827.
Jackson County, Om. 36° 25′ N. 85° 37′ W., found 1846.
Jonesboro, Washington Co., Of. 36° 16′ N. 82° 30′ W., found 1891.
Morristown, Hamblen Co., Mg. 36° 9′ N. 83° 24′ W., found 1887.
Murfreesboro, Rutherford Co., Om. 35° 50′ N. 86° 20′ W., found 1847.
Petersburg, Lincoln Co., Ho. 35° 20′ N. 86° 38′ W., fell Aug. 5, 1855.
Smithville, Dekalb Co., Og. 35° 55′ N. 85° 46′ W., found 1840.
Tazewell, Claiborne Co., Off. 36° 27′ N. 83° 48′ W., found 1853.
Wallens Ridge, Claiborne Co., Og. 36° 30′ N. 83° 30′ W., found 1887.
Stones, 2; ironstones, 2; irons, 12; total, 16. Observed falls, 3.

TEXAS.

Bluff, Fayette Co., Ckb. 29° 52′ N. 96° 48′ W., found 1878.
Carlton, Hamilton Co., Off. 31° 50′ N. 98° 10′ W., found 1887.
Denton County, Om. 33° 14′ N. 97° 8′ W. found 1856.
Estacado, Crosby Co., Cka. 33° 35′ N. 101° 30′ W., found 1906.
Fort Duncan, Maverick Co., H. 28° 35′ N. 100° 24′ W., found 1852.
Iredell, Bosque Co., H. 31° 53′ N. 97° 52′ W., found 1898.
Kendall County, Hb. 29° 24′ N. 98° 30′ W., found 1887.
MacKinney, Collin Co., Cs. 33° 9′ N. 96° 45′ W., found 1870.
Mart, McLennan Co., Off. 31° 10′ N. 96° 45′ W., found 1898.
Pipe Creek, Bandera Co., Cka. 29° 43′ N. 98° 56′ W., found 1887.
Red River, Om. 32° 7′ N. 95° 10′ W., found 1808.
San Angelo, Tom Green Co., Om. 31° 20′ N. 100° 20′ W., found 1897.

San Pedro Springs, Bexar Co., Cw. 29° 27′ N. 98° 27′ W., found 1887.
Travis County, Cs. 30° 20′ N. 97° 29′ W., found 1890.
Wichita County, Og. 34° 0′ N. 98° 40′ W., found 1836.
Stones, 6; irons, 9; total, 15. Observed falls, 0.

UTAH.

Salt Lake City, Salt Lake Co., Cgb. 40° 58′ N. 111° 25′ W., found 1869.
Stones 1; irons, 0; total, 1. Observed falls, 0.

VIRGINIA.

Botetourt County, D. 37° 30′ N. 79° 50′ W., found 1850.
Cranberry Plains, Giles Co., O. 37° 13′ N. 80° 47′ W., found 1852.
Hopper, Henry Co., Om. 36° 35′ N. 79° 45′ W., found 1889.
Indian Valley, Floyd Co., Ha. 36° 58′ N. 80° 39′ W., found 1887.
Richmond, Henrico Co., Cck. 37° 29′ N. 77° 28′ W., fell June 4, 1828.
Staunton, Augusta Co., Om. 38° 14′ N. 79° 1′ W., found 1858.
Stones, 1; irons, 5; total, 6 Observed falls, 1.

WEST VIRGINIA.

Greenbrier County, Og. 37° 32′ N. 80° 18′ W., found 1880.
Jennie's Creek, Wayne Co., Og. 37° 53′ N. 82° 22′ W., found 1883.
Stones, 0; irons, 2; total, 2. Observed falls, 0.

WISCONSIN.

Algoma, Kewaunee Co., Om. 44° 30′ N. 87° 30′ W., found 1887.
Hammond, St. Croix Co., Oh. 44° 55′ N. 92° 22′ W., found 1884.
Trenton, Washington Co., Om. 43° 20′ N. 88° 12′ W., found 1858.
Vernon County, Cka., 43° 30′ N. 91° 10′ W., fell Mar. 26, 1865.
Stones, 1; irons, 3; total, 4. Observed falls, 1.

WYOMING.

Silver Crown, Laramie Co., Og. 41° 10′ N. 105° 20′ W., found 1887.
Stones, 0; irons, 1; total, 1. Observed falls, 0.

FIG 1. LEIGHTON METEORITE. x 2/3.

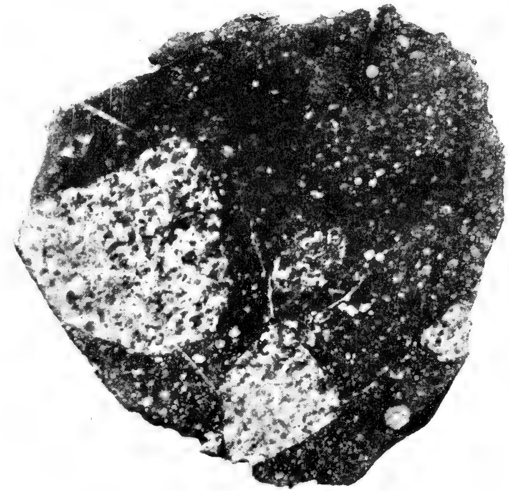
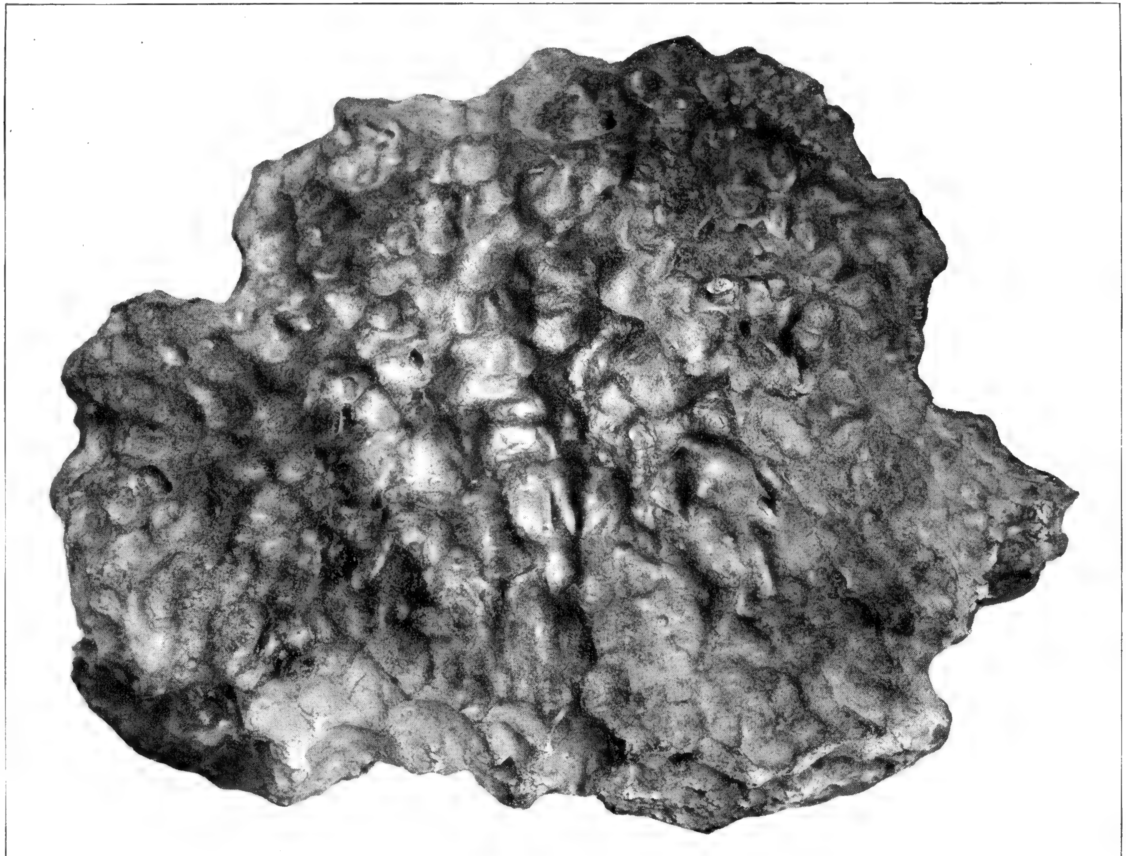


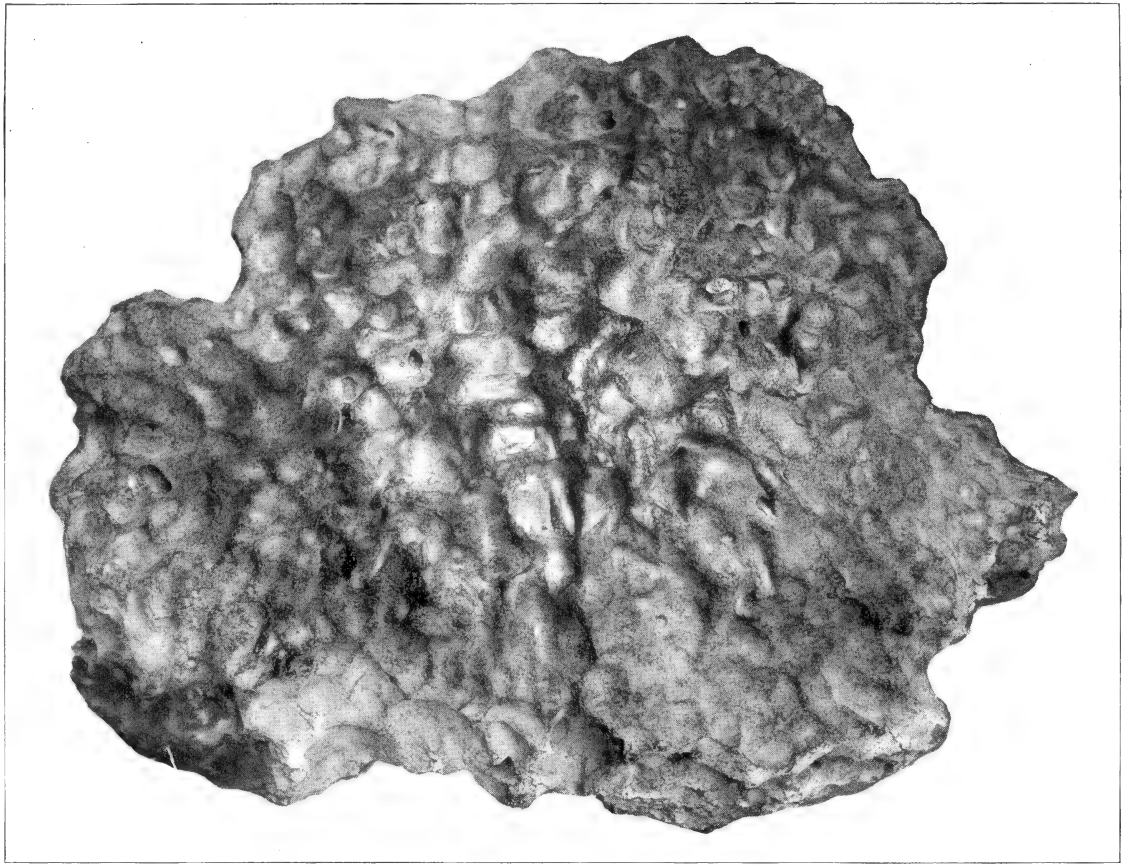
FIG. 2. SECTION OF LEIGHTON METEORITE. x 1.



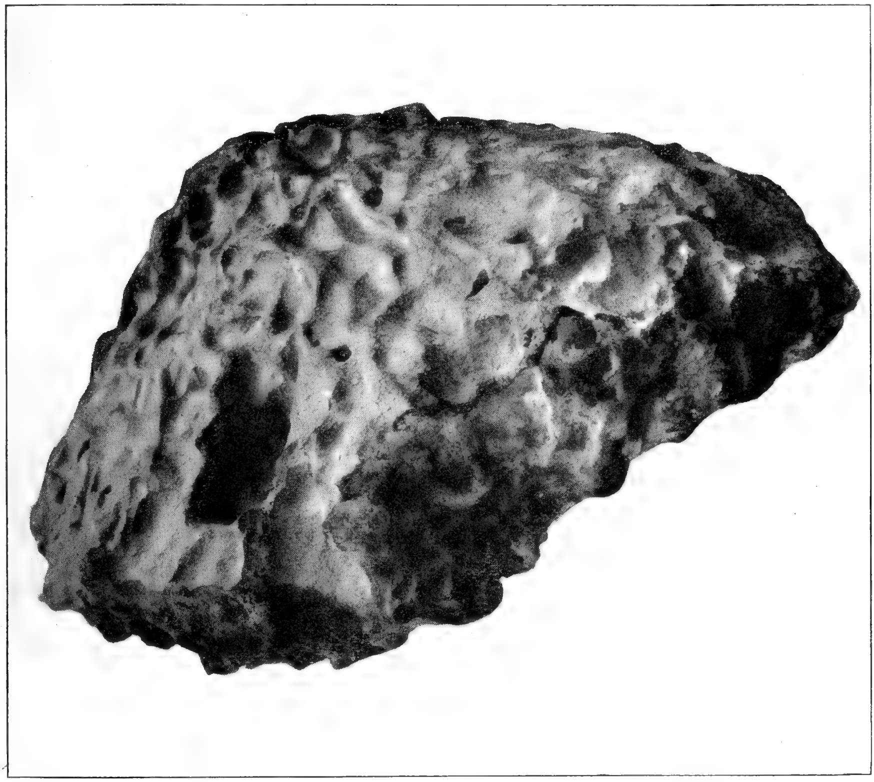
FRONT SIDE OF QUINN CANYON METEORITE. X 1/11.

FIG 1. LEIGHTON METEORITE. X ⅔.

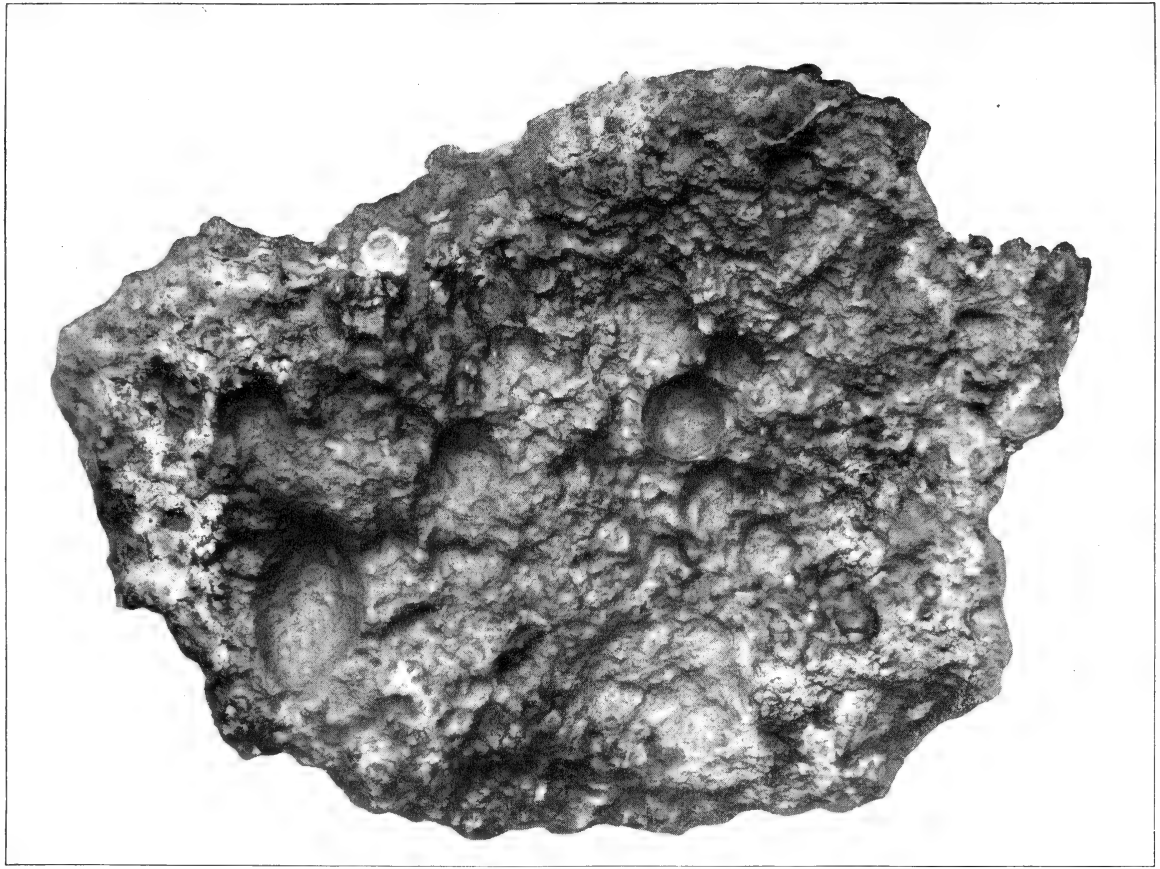
FIG. 2. SECTION OF LEIGHTON METEORITE. X 1.



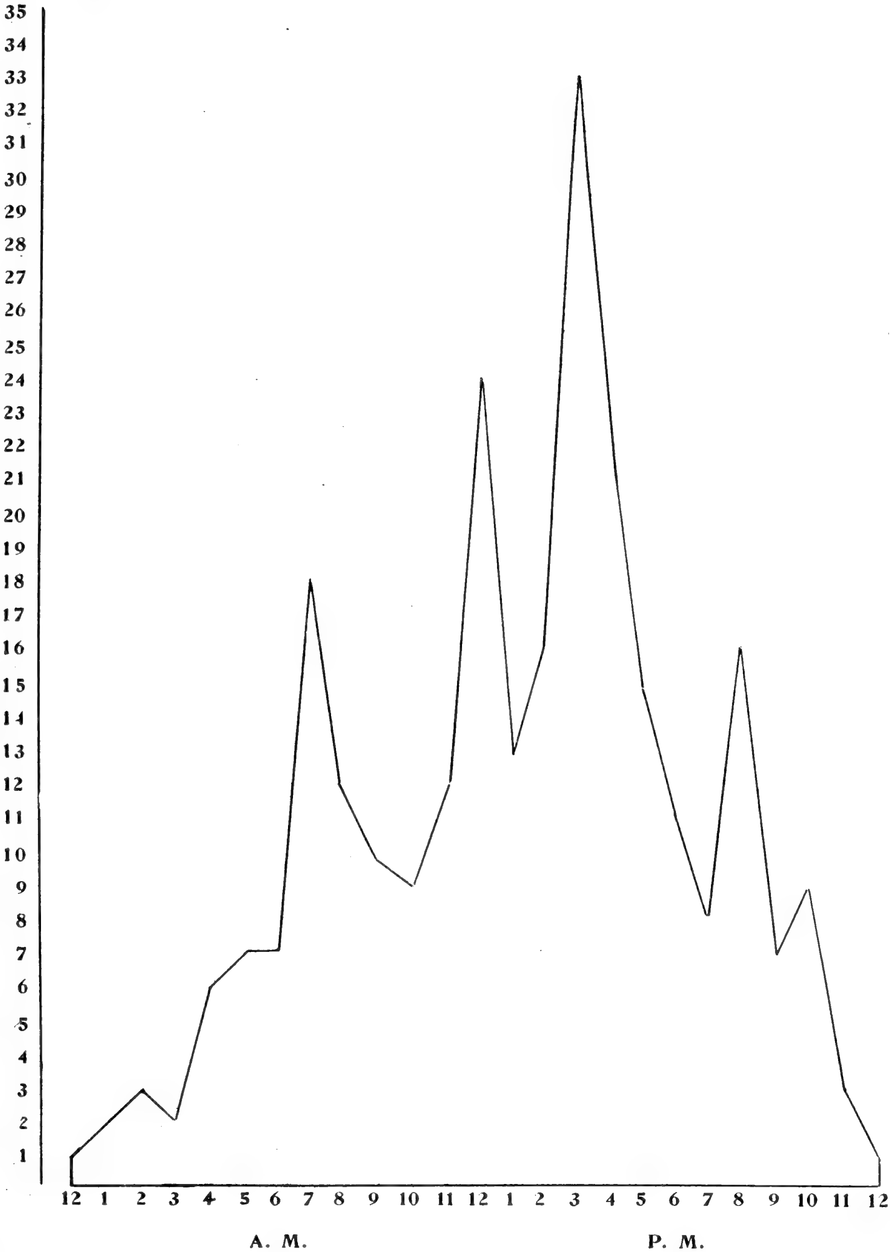
FRONT SIDE OF QUINN CANYON METEORITE. X 1/11.



SIDE VIEW OF QUINN CANYON METEORITE. X 1/7.



Rear Side of Quinn Canyon Meteorite. x 1/11.



Curve of Meteorite Falls by Hours.

ANALYSES OF STONE METEORITES COMPILED AND CLASSIFIED.

BY OLIVER CUMMINGS FARRINGTON.

The object of this publication is twofold: (1) To give a compilation of analyses of stone meteorites of the same nature as that already made by the author for iron meteorites.* (2) To use these analyses as a basis for the establishment of a quantitative classification. The plan on which the analyses have been collected for the first purpose has already been described in the introduction to the paper on Analyses of Iron Meteorites. The need of such a collection is due to the fact that as with the iron meteorites, the last extensive compilation of analyses of stone meteorites which was published was that of Wadsworth in 1884.† Since Wadsworth's compilation a number of excellent analyses have been made both of meteorites which have fallen since that time and of earlier ones, and the convenience of having these analyses grouped together for purposes of reference is obvious. The chief difference between the collection by the present writer of the analyses of the stone meteorites and that of the iron meteorites is that a more rigid selection of the analyses of the stone meteorites has been made. Only those analyses which gave satisfactory evidence of being thorough and complete have been admitted to the list. On the other hand tolerance has been exercised in the admission of analyses which might on the whole be complete although obviously containing minor errors. The greatest difficulty which has been encountered in including analyses in the collection has been that of obtaining mass analyses. It has been a common tendency of analysts of stone meteorites to give only analyses of separate portions. In order to combine the analyses of the separate portions into a mass analysis a reduction of all results to 100 is, of course, necessary. The results thus obtained probably often fail to accurately represent all the constituents of the meteorite, but on the

* Analyses of Iron Meteorites Compiled and Classified, Field Col. Mus. Pub. 1907, Geol. Ser., Vol. 3, pp. 59–110.

† Rocks of the Cordilleras; Mem. Mus. Comp. Zool. Cambridge, Mass., 1884, Vol. II, pt. 1, pp. XVI–XXXIII.

whole no serious error need be involved. To confine reported analyses to those which were only stated in the mass form would reduce the number materially and fail to represent our true knowledge of the chemical composition of meteorites.

The second purpose for which the grouping of the analyses has been made was, as has been stated, to propose a quantitative classification. The principles of this classification are the same as those for terrestrial rocks proposed by Cross, Iddings, Pirsson, and Washington.* It was suggested by Washington in his publication on the Chemical Analyses of Igneous Rocks and their Classification† that such a classification of meteorites be made, and the writer held a brief conference with Dr. Washington on the subject. The need of such a classification of meteorites is, perhaps, even more acute than was the case with terrestrial rocks. Of the various classifications of meteorites which have been proposed none can be considered quantitative. The classification chiefly used for stone meteorites at the present time is that which has been gradually evolved through the labors of Rose, Tschermak, Cohen, and Brezina. It is presented in its most complete form by Brezina in the Catalogue of the Ward-Coonley Collection of Meteorites.‡ As is well known, the groups of this classification are based primarily upon structure but also upon mineralogical characters. The stones are first subdivided into achondrites, chondrites, and siderolites. The achondrites are divided into a number of groups distinguished by mineralogical composition. These include the eukrites, chladnites, howardites, etc. Among the chondrites the subdivisions are based chiefly on color, the groups being designated as white, gray, black, intermediate, carbonaceous, etc., with additional divisions according to structure giving spherulitic and crystalline. Other subdivisions are based upon the presence or absence of veins and breccia-like structure. Of these divisions, that according to color cannot be regarded as resting upon any important or fundamental character, although it finds some slight justification in the fact that the lighter-colored meteorites are likely to contain more enstatite than the darker ones. Another weak feature of the classification in the view of the present writer is its failure to take account, in any definite way, of the metallic content of meteorites. The metal of meteorites is an important feature which should serve as a distinguishing mark.

So far as the iron meteorites are concerned the present system of

* Quantitative Classification of Igneous Rocks, Chicago, 1903.

† U. S. Geological Survey, 1903, Prof. Pap. No. 14, pp. 9 and 61.

‡ Henry A. Ward, Chicago, 1904, pp. 97–101.

Brezina is quantitative, as the present writer has shown.* The metallic content of the stone meteorites, however, finds little recognition in the Brezina system.

It will be obvious that some modification of the Quantitative Classification of terrestrial rocks is necessary in order to fit it for use with meteorites. Among these one is due to the impossibility of using regional names for the nomenclature of orders, sections, etc., of meteorites. For this reason in designation of the subdivisions the writer has used only descriptive adjectives. A group name is given only to the last group, the subrang. This name is that of a meteorite as nearly representative in composition as possible, preference being given, where there is a choice of names, to the better known meteorites. Another modification of classification necessary has been on account of the abundance of metal in meteorites. This required the formation of several subclasses in the classes in which among terrestrial rocks but a single subclass exists. Two subclasses are thus required in Class IV and four in Class V. As no nomenclature was proposed by the authors of the Quantitative Classification which would be applicable to more than one subclass, it has been necessary for the writer to provide names for the additional subclasses. This has been done by coining adjective terms indicating the relative quantities of silicates and metal. The adjectives for the five subdivisions are: persilicic, dosilicic, silico-metallic, dometallic, and permetallic. As will be noted by consulting the tables, most meteorites fall outside of the groups of terrestrial rocks. The following groups are similar in meteorites and terrestrial rocks: Kedabdekase of terrestrial rocks corresponds to Juvinose of meteorites; Wehrlose to Udenose; Argeinose to Stawropolose; Maricose to Bishopvillose; and Websterose to Bustose. Some minerals not found in terrestrial rocks occur in meteorites. To these the writer has given the following abbreviations: troilite, *tr;* oldhamite, *oh;* nickel-iron, *nf*. As it is occasionally necessary to assume the presence of the molecule (Mg, Fe)O in meteorites, the name *femite* and abbreviation *mo* are proposed for it. The standard minerals assumed to be present in meteorites and their abbreviations are then as follows:

GROUP I: SALIC MINERALS

Quartz, $Si\,O_2$		Q
Zircon, $Zr\,O_2 \,.\, Si\,O_2$		Z
Orthoclase, $K_2\,O \,.\, Al_2\,O_3 \,.\, 6\,Si\,O_2$	or	F
Albite, $Na_2\,O \,.\, Al_2\,O_3 \,.\, 6\,Si\,O_2$	ab	F
Anorthite, $Ca\,O \,.\, Al_2\,O_3 \,.\, 2\,Si\,O_2$	an	F

* Field Col. Mus. Pub. 1907, Geol. Ser., Vol. 3, p. 108.

Leucite, $K_2O . Al_2O_3 . 4 SiO_2$	lc	L	
Nephelite, $Na_2O . Al_2O_3 . 2 SiO_2$	ne	L	
Kaliophilite, $K_2O . Al_3O_2 2 SiO_2$	kp	L	

GROUP II: FEMIC MINERALS

Acmite, $Na_2O . Fe_2O_3 . 4 SiO_2$	ac	P	
Sodium metasilicate, $Na_2O . SiO_2$	ns	P	
Potassium metasilicate, $K_2O . SiO_2$	ks	P	
Diopside, $CaO . (Mg, Fe) O . 2 SiO_2$	di	P	
Wollastonite, $CaO . SiO_2$	wo	P	
Hypersthene, $(Mg, Fe) O . SiO_2$	hy	P	
Olivine, $2 (Mg, Fe) O . SiO_2$	ol	O	
Akermanite, $4 CaO . 3 SiO_2$	am	O	
Magnetite, $FeO . Fe_2O_3$	mt	H	M
Femite, Mg, Fe O	mo	H	M
Chromite, $FeO . Cr_2O_3$	om	H	M
Hematite, Fe_2O_3	hm	H	M
Ilmenite, $FeO . TiO_2$	il	T	M
Apatite, $3 (3 CaO . P_2O_5) . CaF_2$	ap	A	
Troilite, Fe S	tr	A	
Oldhamite, Ca S	oh	A	
Schreibersite, $(Fe, Ni)_3 P$	sc	A	
Nickel-iron, Fe_n, Ni_m	nf	A	

The methods of calculating the analyses of meteorites in order to determine their place in this classification are the same as those adopted for terrestrial rocks by the authors of the Quantitative Classification. These are given in detail in their publication. As it may be convenient, however, to have the quantitative classification of meteorites so far as possible complete in itself, so much of the methods of calculation as is deemed necessary is here repeated from the work of the authors of the Quantitative Classification.*

1. Determine the molecular proportions of the chemical components of a rock as expressed by the complete analysis, by dividing the percentage weights of each component by its molecular weight.

2. Before undertaking the distribution of the chemical components as mineral molecules, small amounts of Mn O and Ni O are to be united with Fe O, and of Ba O and Sr O with Ca O; of Cr_2O_3 with Fe_2O_3, unless these unusual components occur in sufficient amounts to make their calculation as special mineral molecules desirable.

3. Establish the fixed molecules by allotting:

a) to Cr_2O_3, if present in notable amount, Fe O to satisfy the ratio $Cr_2O_3 : FeO :: 1 : 1$ for chromite:

b) to TiO_2 enough Fe O to satisfy the ratio $TiO_2 : FeO :: 1 : 1$ for ilmenite. If there is excess of TiO_2, allot to it equal Ca O for titanite or perofskite according to available silica, to be determined later. If there is an excess of TiO_2 it is to be calculated as rutile.

* *Loc. cit.* pp. 188–195.

c) to P_2O_5 allot enough $Ca\,O$ to satisfy the ratio $P_2O_5 : Ca\,O :: 1 : 3.33$ for apatite. Allot F or Cl to satisfy $Ca\,O = 0.33\ P_2O_5$;

d) to F not used in apatite allot $Ca\,O$ to form fluorite, $Ca\,O : F :: 1 : 2$;

e) to Cl allot Na_2O in the ratio $Cl_2 : Na_2\,(O) :: 1 : 1$ for sodalite;

f) to SO_3 allot Na_2O in proportion $SO_3 : Na_2O :: 1 : 1$ for noselite;

g) to S allot $Fe\,O$ in proportion $S : Fe\,(O) :: 2 : 1$ for pyrite;

h) to $C\,O_2$ in undecomposed rocks allot $Ca\,O$ in the proportion $1 : 1$ for calcite. CO_2 may occur in primary calcite and cancrinite. If these minerals are secondary, the CO_2 is to be neglected, since it is understood that analyses of decomposed rocks are not available for purposes of classification.

Having adjusted the minor, inflexible, molecules, there remain the more important but variable silicate molecules, which form the great part of the mineral composition, or *norm*, of most rocks.

4. To Al_2O_3 are allotted all the K_2O and Na_2O not already disposed of, in the proportion of $Al_2O_3 : K_2O + Na_2O :: 1 : 1$ for alkali feldspathic and feldspathoid (lenad) molecules.

5. With excess of Al_2O_3, ($Al_2O_3 > K_2O + Na_2O$);

a) to extra Al_2O_3 allot $Ca\,O$ in proportion of $Al_2O_3 : Ca\,O :: 1 : 1$ for anorthite molecules.

b) If there is further excess of Al_2O_3 it is to be considered as corundum, Al_2O_3.

6. With insufficient Al_2O_3, ($Al_2O_3 < K_2O + Na_2O$);

a) Extra Na_2O is alloted to Fe_2O_3 in proportion $Fe_2O_3 : Na_2O :: 1 : 1$ for acmite molecules.

b) If there is still extra Na_2O it is set aside for a metasilicate molecule ($Na_2\,Si\,O_3$).

c) When there is an excess of K_2O over Al_2O_3 it is treated in the same manner. It is an extremely rare occurrence.

7. In working with reliable analyses in which Fe_2O_3 and $Fe\,O$ have been correctly determined:

a) To Fe_2O_3 is allotted excess of Na_2O under conditions 6, *a*).

b) To remaining Fe_2O_3 is allotted available $Fe\,O$ in equal proportions for magnetite.

c) If there is any excess of Fe_2O_3 it is calculated as hematite.

Analyses in which all the iron has been determined in one form of oxidation, when it occurs in two, are of little value when considerable iron is present. When the amount of iron is very small the analyses may still be used as a means of classifying the rock. For this purpose all the iron, if given as ferric oxide, is to be calculated as $Fe\,O$, except that necessary to be allotted to Na_2O for acmite, and then used as below.

8. *a*) Extra $Ca\,O$ after the foregoing assignments is allotted to $(Mg, Fe)\,O$ in proportion $Ca\,O : (Mg, Fe)\,O :: 1 : 1$ for diopside molecules.

In all molecules where $(Mg, Fe)\,O$ is present, $Mg\,O$ and $Fe\,O$ are to be used in the same proportions in which they are found after $Fe\,O$ has been allotted to the molecules previously mentioned. That is, they are to be introduced into diopside, hypersthene, and olivine with the same ratio between them.

b) If there is still an excess of $Ca\,O$ it is to be set aside for calcium metasilicate ($Ca\,Si\,O_3$) or subsilicate ($4\,Ca\,O\,.\,3\,Si\,O_2$), equivalent to wollastonite or akermanite. Such extra $Ca\,O$ will in most cases actually enter garnet, an alferric mineral.

9. With insufficient $Ca\,O$, ($Ca\,O < (Mg, Fe)\,O$);

a) Extra $(Mg, Fe)\,O$ is to be set aside for metasilicate or orthosilicate, hypersthene or olivine, according to the amount of $Si\,O_2$ present.

The allotment of $Si\,O_2$ to form silicates begins with the bases which occur with silica in but one proportion, and is carried on as follows:

10. To $Zr\,O_2$ allot $Si\,O_2$ in proportion of 1 : 1 for zircon.

11. To $Ca\,O$ and $Al_2\,O_3$ in anorthite is allotted equal $Si\,O_2$ to form $Ca\,O.Al_2\,O_3.2\,Si\,O_2$.

12. To $Ca\,O$ and $(Mg, Fe)\,O$ in diopside is allotted equal $Si\,O_2$ to form $Ca\,O.(Mg, Fe)\,O.2\,Si\,O_2$.

13. To $Na_2\,O$ and $Fe_2\,O_3$ in acmite is allotted $Si\,O_2$ to form $Na_2\,O.Fe_2\,O_3.4\,Si\,O_2$.

14. To $Na_2\,O$ (or $K_2\,O$) set aside for metasilicate molecules allot $Si\,O_2$ to form $Na_2\,O.Si\,O_2$ or $K_2\,O.Si\,O_2$.

15. To $Na_2\,O$ and $Al_2\,O_3$ in sufficient amount to form with $Na\,Cl$ sodalite, or with $Na_2\,SO_4$ noselite, is allotted $Si\,O_2$ to satisfy the formulas : $3\,(Na_2\,O.Al_2\,O_3\,2Si\,O_2).2\,Na\,Cl$, sodalite, $2\,(Na_2\,O.Al_2\,O_3.2\,Si\,O_2).Na_2\,SO_4$ noselite.

16. To $Ca\,O$ set aside for wollastonite or akermanite is allotted tentatively $Si\,O_2$ to form wollastonite ($Ca\,O.Si\,O_2$).

17. To extra $(Mg, Fe)\,O$ is allotted $Si\,O_2$ to form orthosilicate, olivine ($2\,(Mg, Fe)\,O.Si\,O_2$).

18. To $Al_2\,O_3$ and $K_2\,O + Na_2\,O$ is allotted $Si\,O_2$ to make the polysilicates, orthoclase and albite, $K_2\,O.Al_2\,O_3.6\,Si\,O_2$ and $Na_2\,O.\,Al_2\,O_3.6\,Si\,O_2$.

a) If there is an excess of $Si\,O_2$ it is added to the orthosilicate of $(Mg, Fe)\,O$ to raise it to the metasilicate $(Mg, Fe)\,O.Si\,O_2$. If $Si\,O_2$ is insufficient to convert all the olivine into hypersthene it is distributed according to the following equations:

$$x + y = \text{molecules of } (Mg, Fe)\,O.$$

$$x + \frac{y}{2} = \text{available } Si\,O_2.$$

where x = hypersthene, $\frac{y}{2}$ = olivine molecules.

b) Further excess of $Si\,O_2$ is to be allotted to $Ti\,O_2$ and $Ca\,O$ to form titanite. These constituents remain as perofskite when there is no excess of $Si\,O_2$.

c) Further excess of $Si\,O_2$ is reckoned as quartz.

19. If there is insufficient $Si\,O_2$ to form polysilicate feldspar out of all the $K_2\,O$ and $Na_2\,O$ with $Al_2\,O_3$:

a) To $K_2\,O.Al_2\,O_3$ is allotted tentatively enough $Si\,O_2$ to form polysilicate, orthoclase ($K_2\,O.Al_2\,O_3.6\,Si\,O_2$) and the remaining $Si\,O_2$ is distributed between albite and nephelite molecules by means of the equations:

$$x + y = \text{molecules of } Na_2\,O.$$
$$6x + 2y = \text{available } Si\,O_2.$$

where x = albite, and y = nephelite molecules.

b) If the available $Si\,O_2$ in case 15, *a*) is insufficient to form nephelite with the $Na_2\,O$, then enough $Si\,O_2$ is first allotted to the $Na_2\,O$ to form nephelite and the remaining $Si\,O_2$ is distributed between orthoclase and leucite molecules by means of the equations:

$$x + y = \text{molecules of } K_2\,O.$$
$$6x + 4y = \text{available } Si\,O_2.$$

where x = orthoclase, and y = leucite molecules.

20. If there is insufficient $Si\,O_2$ to form leucite and nephelite with olivine it is necessary to reduce a sufficient number of molecules to form the subsilicate akermanite, $4Ca\,O.3\,Si\,O_2$.

a) In case there is no wollastonite this is done after distributing $Si\,O_2$ tentatively to form leucite, nephelite, and olivine, and noting the deficit of $Si\,O_2$ by means of the equation:

$$y = \frac{1}{3} \text{ of the deficit of } Si\,O_2.$$
$$y = \text{molecules of akermanite.} \quad (4\,Ca\,O.3\,Si\,O_2).$$

$Ca\,O$ is to be taken from diopside, and the $Mg\,O$ and $Fe\,O$ so liberated are to be calculated as olivine.

b) In case an excess of $Ca\,O$ has been set aside for wollastonite this is first converted to akermanite by means of the equations:

$$y = \text{the deficit of } Si\,O_2.$$
$$y = \text{molecules of akermanite } (4\,Ca\,O.3\,Si\,O_2).$$

c) If there are not sufficient molecules of wollastonite to satisfy the deficit of silica, recalculate the molecules of diopside and wollastonite so as to make olivine, diopside, and akermanite by means of the formulæ:

$$2x + 3y + \frac{z}{2} = \text{available } Si\,O_2.$$
$$x + 4y = \text{molecules of } Ca\,O.$$
$$x + z = \text{molecules of } Mg\,O + Fe\,O.$$

where x = molecules of new diopside, y = molecules of akermanite ($4\,Ca\,O.3\,Si\,O_2$), and z = molecules of olivine.

21. If there is still not enough $Si\,O_2$, all the $Ca\,O$ of the diopside and wollastonite must be calculated as akermanite, the $(Mg, Fe)\,O$ being reckoned as olivine and the $K_2\,O$ distributed between leucite and kaliophilite by the equations:

$$x + y = \text{molecules of } K_2\,O.$$
$$4x + 2y = \text{available } Si\,O_2.$$

where x is $K_2\,O$ in leucite and y = $K_2\,O$ in kaliophilite.

22. In case there is insufficient $Si\,O_2$ and an excess of $Al_2\,O_3$ and $(Mg, Fe)\,O$, which might form aluminum spinel, an alferric mineral, the excess of $Al_2\,O_3$ is to be calculated as corundum, and the uncombined $(Mg, Fe)\,O$ is to be estimated as femic minerals, being placed with the nonsilicate, mitic group, magnetite, ilmenite, etc.

GLOSSARY

A

Alkalicalcic. Having salic alkalies and salic lime present in equal or nearly equal amounts. $\frac{K_2O' + Na_2O'}{CaO'} < \frac{5}{3} > \frac{3}{5}$.

C

Calcimiric. Equally calcic and miric, or nearly so. $\frac{MgO + FeO}{CaO} < \frac{5}{3} > \frac{3}{5}$.

Class. Division of igneous rocks based on the relative proportions of salic and femic standard minerals.

D

Do- (or dom) Prefix indicating that one factor dominates over another within the ratios $\frac{7}{1}$ and $\frac{5}{3}$.

Docalcic. Dominantly calcic. Of salic minerals when CaO' dominates over $K_2O' + Na_2O'$. $\frac{K_2O' + Na_2O'}{CaO'} < \frac{3}{5} > \frac{1}{7}$. Of femic minerals when CaO'' dominates over $MgO + FeO$. $\frac{MgO + FeO}{CaO''} < \frac{3}{5} > \frac{1}{7}$.

Dofelic. Dominantly felic, having normative feldspar dominant over normative quartz or lenads. $\frac{Q \text{ or } L}{F} < \frac{3}{5} > \frac{1}{7}$.

Dofemane. Class IV of igneous rocks, having femic minerals dominant over salic.

$$\frac{Sal}{Fem} < \frac{3}{5} > \frac{1}{7}.$$

Dofemic. Dominantly femic, having femic minerals dominant over salic.

$$\frac{Sal}{Fem} < \frac{3}{5} > \frac{1}{7}.$$

Doferrous. Dominantly ferrous, having FeO dominant over MgO.

$$\frac{MgO}{FeO} < \frac{3}{5} > \frac{1}{7}.$$

Domagnesic. Dominantly magnesic, having MgO dominant over FeO.

$$\frac{MgO}{FeO} < \frac{7}{1} > \frac{5}{3}.$$

Domalkalic. Dominantly alkalic; of salic minerals when $K_2O' + Na_2O'$ dominates over CaO'. $\frac{K_2O' + Na_2O'}{CaO'} < \frac{7}{1} > \frac{5}{3}$. Of femic minerals when $K_2O'' + Na_2O''$ dominates over $MgO + FeO + CaO''$.

$$\frac{MgO + FeO + CaO''}{K_2O'' + Na_2O''} < \frac{3}{5} > \frac{1}{7}.$$

Domiric. Dominantly miric, having Mg O + Fe O dominant over Ca O″.

$$\frac{\mathrm{Mg\,O + Fe\,O}}{\mathrm{Ca\,O''}} < \frac{7}{1} > \frac{5}{3}.$$

Domirlic. Dominantly mirlic, having Mg O + Fe O + Ca O″ dominant over $K_2\,O'' + Na_2\,O''$. $\frac{\mathrm{Mg\,O + Fe\,O + Ca\,O''}}{\mathrm{K_2\,O + Na_2\,O''}} < \frac{7}{1} > \frac{5}{3}$.

Domitic. Dominantly mitic, having mitic minerals (magnetite, hematite, ilmenite, titanite, etc.) dominant over polic minerals (pyroxene, olivine, akermanite).

$$\frac{\mathrm{PO}}{\mathrm{M}} < \frac{3}{5} > \frac{1}{7}.$$

Domolic. Dominantly olic, having normative olivine and akermanite dominant over normative pyroxenes. $\frac{\mathrm{P}}{\mathrm{O}} < \frac{3}{5} > \frac{1}{7}$.

Dopolic. Dominantly polic, having polic minerals (pyroxene, olivine) dominant over mitic minerals (magnetite, ilmenite, etc.). $\frac{\mathrm{PO}}{\mathrm{M}} < \frac{7}{1} > \frac{5}{3}$.

Dopotassic. Dominantly potassic, having $K_2\,O$ dominant over $Na_2\,O$.

$$\frac{\mathrm{K_2\,O}}{\mathrm{Na_2\,O}} < \frac{7}{1} > \frac{5}{3}.$$

Dopyric. Dominantly pyric, having normative pyroxene dominant over normative olivine and akermanite. $\frac{\mathrm{P}}{\mathrm{O}} < \frac{7}{1} > \frac{5}{3}$.

Doquaric. Dominantly quaric, having normative quartz dominant over normative feldspar. $\frac{\mathrm{Q}}{\mathrm{F}} < \frac{7}{1} > \frac{5}{3}$.

Dosalic. Dominantly salic, having the salic minerals dominant over the femic.

$$\frac{\mathrm{Sal}}{\mathrm{Fem}} < \frac{7}{1} > \frac{5}{3}.$$

Dosodic. Dominantly sodic, having $Na_2\,O$ dominant over $K_2\,O$.

$$\frac{\mathrm{K_2\,O}}{\mathrm{Na_2\,O}} < \frac{3}{5} > \frac{1}{7}.$$

E

Extreme. Said of a factor that is present alone or in amount greater than 7:1 of the other factor.

F

Felic. Having the properties of, or containing, the feldspars.

Fem. Term mnemonic of the second group of standard minerals, including non-aluminous ferromagnesian and calcic silicates, silicotitanates and non-siliceous and non-aluminous minerals.

Femic. Having the character of, or belonging to, the second (fem) group of standard minerals.

L

Len. Syllable mnemonic of leucite and nephelite, including sodalite and noselite, the feldspathoids.

Lenad. One of the standard minerals, leucite, nephelite, sodalite or noselite.

M

Magnesiferrous. Equally magnesic and ferrous, or nearly so.

$$\frac{Mg\,O}{Fe\,O} < \frac{5}{3} > \frac{3}{5}.$$

Mir. Syllable mnemonic of magnesia and ferrous iron.

Miric. Characterized by presence of Mg O and Fe O.

Mirl. Syllable mnemonic of magnesia, ferrous iron, and lime.

Mirlic. Characterized by presence of Mg O, Fe O, and Ca O.

Mit. Syllable mnemonic of magnetite, ilmenite, and titanite, and including all minerals of the second subgroup of femic minerals.

Mitic. Adjective referring to the above mentioned minerals.

Mode. The actual mineral composition of a rock. Opposed to norm, with which it may or may not coincide.

O

Ol. Syllable mnemonic of olivine, embracing also akermanite.

Olic. Having the proportions of, or containing, normative olivine or akermanite.

Order. A division of Subclass based on the relative proportions of the standard mineral subgroups in the preponderant group.

P

Per- Prefix to indicate that a factor is present alone, or in extreme amount; that is, its ratio to another factor is $> \frac{7}{1}$.

Peralkalic. Extremely alkalic. Of salic minerals when $K_2O' + Na_2O'$ is more than seven times $Ca\,O'$. $\frac{K_2O' + Na_2O'}{Ca\,O'} > \frac{7}{1}$. Of femic minerals when $K_2O'' + Na_2O''$ is more than seven times $Mg\,O + Fe\,O + Ca\,O''$.

$$\frac{Mg\,O + Fe\,O + Ca\,O''}{K_2O'' + Na_2O''} < \frac{1}{7}.$$

Percalcic. Extremely calcic. Of salic minerals when $Ca\,O'$ is more than seven times $K_2O' + Na_2O'$. $\frac{K_2O' + Na_2O'}{Ca\,O'} < \frac{1}{7}$. Of femic minerals when $Ca\,O''$ is more than seven times $Mg\,O + Fe\,O$. $\frac{Mg\,O + Fe\,O}{Ca\,O''} < \frac{1}{7}$.

Perfelic. Extremely felic. When normative feldspar is more than seven times the normative quartz or lenads. $\frac{Q \text{ or } L}{F} < \frac{1}{7}$.

Perfemane. Class V of igneous rocks, having femic minerals extremely abundant.

$$\frac{Sal}{Fem} < \frac{1}{7}.$$

Perfemic. Extremely femic. Having femic minerals more than seven times the salic.

$$\frac{Sal}{Fem} < \frac{1}{7}.$$

Perferrous. Extremely ferrous. When Fe O is more than seven times Mg O.

$$\frac{Mg\,O}{Fe\,O} < \frac{1}{7}.$$

Permagnesic. Extremely magnesic; having Mg O more than seven times Fe O.

$$\frac{\text{Mg O}}{\text{Fe O}} > \frac{7}{1}.$$

Permiric. Extremely miric; having Mg O + Fe O more than seven times Ca O″.

$$\frac{\text{Mg O} + \text{Fe O}}{\text{Ca O}''} > \frac{7}{1}.$$

Permirlic. Extremely mirlic; having Mg O + Fe O + Ca O″ more than seven times K_2 O″ + Na_2 O″. $\frac{\text{Mg O} + \text{Fe O} + \text{Ca O}''}{K_2\text{O}'' + Na_2\text{O}''} > \frac{7}{1}.$

Perolic. Extremely olic; having olic minerals (olivine, akermanite) more than seven times the pyric minerals (pyroxenes). $\frac{P}{O} < \frac{1}{7}.$

Perpolic. Extremely polic, having polic minerals (pyroxenes, olivine, akermanite) more than seven times the mitic minerals (magnetite, ilmenite, titanite, hematite, etc.). $\frac{PO}{M} > \frac{7}{1}.$

Perpotassic. Extremely potassic, having K_2 O′ more than seven times Na_2 O′.

$$\frac{K_2\text{O}'}{Na_2\text{O}'} > \frac{7}{1}.$$

Perpyric. Extremely pyric, having pyric minerals (pyroxenes) more than seven times the olic minerals (olivine, akermanite). $\frac{P}{O} > \frac{7}{1}.$

Perquarfelic. Extremely quarfellenic; having normative quartz, feldspar, and feldspathoids more than seven times corundum and zircon. $\frac{QFL}{CZ} > \frac{7}{1}.$

Perquaric. Extremely quaric; having normative quartz more than seven times the normative feldspar. $\frac{Q}{F} > \frac{7}{1}.$

Pol. Syllable mnemonic of the femic silicates pyroxenes and olivine, including akermanite.

Polic. Characterized by the presence of the femic silicates.

Polmitic. Having equal or nearly equal amounts of polic and mitic minerals.

$$\frac{PO}{M} < \frac{5}{3} > \frac{3}{5}.$$

Pyr. Syllable mnemonic of pyroxenes.

Pyrolic. Having equal, or nearly equal amounts of normative pyroxene and olivine or akermanite. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}.$

Q

Quar. Syllable mnemonic of quartz.

Quardofelic. Having felic minerals (feldspar) dominant over normative quartz.

$$\frac{Q}{F} < \frac{7}{1} > \frac{5}{3}.$$

Quarfelic. Having equal or nearly equal amounts of normative quartz and feldspars.

$$\frac{Q}{F} < \frac{5}{3} > \frac{3}{5}.$$

R

Rang. (Old form of rank.) Division of Order based on the character of the chemical bases in the preponderant group of standard minerals.

S

Sal. Syllable mnemonic of the silico-aluminous non-ferromagnesian group of standard minerals, including quartz, feldspars, lenads, corundum and zircon.

Salfemane. Class III of igneous rocks; having salic and femic minerals in equal or nearly equal proportions. $\frac{\text{Sal}}{\text{Fem}} < \frac{5}{3} > \frac{3}{5}$.

Salfemic. Having salic and femic minerals in equal or nearly equal amounts.

$$\frac{\text{Sal}}{\text{Fem}} < \frac{5}{3} > \frac{3}{5}.$$

Salic. Having the characters of, or belonging to, the first (sal) group of standard minerals.

Section. Subdivision of any of the other taxonomic divisions from Class to Subgrad.

Subrang. Division of Rang, based on the character of the chemical bases in the preponderant mineral subgroup used in forming Rang.

In order to still further indicate the manner in which the calculations upon which the place of each meteorite in the classification is based are made, two examples of such calculations are here given. The first illustrates the calculation of the mineral components which characterize the great majority of the stony meteorites, the analysis chosen for the calculation being one of the Allegan meteorite made by Stokes.

In the second example is shown the manner of adjusting silica among the different minerals after a preliminary calculation has indicated that too little silica is present to form the more highly siliceous ones. The analysis is one of Felix made by Fireman.

EXAMPLE I

ALLEGAN

Proc. Washington Acad. Sci. 1900, 2, 51

	Per Cent.	Mol.	Apat.	Ilm.	Chrom.	Orth.	Alb.	An.	Diop.	Rem'der.	Hyp.	Oliv.
SiO_2	34.95	583	..	..	..	12	66	24	22	459	262	197
Al_2O_3	2.55	25	..	..	..	2	11	12	..	..	..	..
Cr_2O_3	.53	3	..	..	3	..	..	..	..	..	..	..
FeO	8.47	118	..	1	3	..	..	..				
MnO	.18	3	..	..	..	..	..	..	11	656	262	394
MgO......	21.99	550	..	..	..	..	..	..				
CaO......	1.73	30	7	..	..	..	..	12	11	..	..	..
Na_2O	.66	11	..	..	..	..	11	..	..	..	..	..
K_2O	.23	2	..	..	..	2	..	..	..	..	..	..
H_2O	.25	..	..	..	..	..	..	..	..	..	..	..
TiO_2	.08	1	..	1	..	..	..	..	..	..	..	..
Fe	21.09	..	..	..	..	..	..	..	..	..	..	..
Ni	1.81	..	..	..	..	..	..	..	..	..	..	..
Co	.05	..	..	..	..	..	..	..	..	..	..	..
Cu	.01	..	..	..	..	..	..	..	..	..	..	..
Fe S.......	5.05	..	..	..	..	..	..	..	..	..	..	..
P_2O_5	.27	2	2	..	..	..	..	..	..	..	..	..
Sum.......	100.00	..	..	..	..	..	..	..	..	..	..	..

$$x + y = 656 \text{ (Mg. Fe) O}$$

$$x + \frac{y}{2} = 459 \text{ Si O}_2$$

$$x = 262$$

$$y = 394$$

Formula	Mol. Wt.		Norm			
$K_2O.Al_2O_3.6SiO_2$ ..	2 × 556	= orthoclase	= 1.11	F 10.21	Sal 10.21.	
$Na_2O.Al_2O_3.6SiO_2$.	11 × 524	= albite	= 5.76			
$CaO.Al_2O_3.2SiO_2$..	12 × 278	= anorthite	= 3.34			
$CaO.SiO_2$.......	11 × 116	= diopside	= 2.44	P 30.11	P + O 59.90	Fem 89.45
$MgO.SiO_2$......	9 × 100					
$FeO.SiO_2$.......	2 × 132					
$MgO.SiO_2$......	216 × 100	= hypersthene	= 27.67			
$FeO.SiO_2$.......	46 × 132					
$2MgO.SiO_2$.....	325 × 70	= olivine	= 29.79	O		
$2FeO.SiO_2$......	69 × 102					
$FeO.Cr_2O_3$........	3 × 224	= chromite	= .67	M	.82	
$FeO.TiO_2$........	1 × 152	= ilmenite	= .15			
$3CaO.P_2O_5$.......	2 × 310	= apatite	= .62	A	28.73	
Fe S..............		= troilite	= 5.05			
$Fe_n Ni_m$...........		= nickel-iron	= 23.06			
			99.66			

Perfemic $\qquad$ Dosilicic $\qquad$ Perpolic $\qquad$ Pyrolic

$$\frac{\text{Sal}}{\text{Fem}} = \frac{10.21}{89.45} < \frac{1}{7}, \quad \frac{\text{POM}}{\text{A}} = \frac{60.72}{28.73} < \frac{7}{1} > \frac{5}{3}, \quad \frac{\text{PO}}{\text{M}} = \frac{59.90}{.82} > \frac{7}{1}, \quad \frac{\text{P}}{\text{O}} = \frac{30.11}{29.79} < \frac{5}{3} > \frac{3}{5}$$

Permirlic $\qquad$ Permiric $\qquad$ Domagnesic

$$\frac{\text{Ca O} + \text{Mg O} + \text{Fe O}}{\text{Na}_2\text{O}} = \frac{690}{11} > \frac{7}{1}, \quad \frac{\text{Mg O} + \text{Fe O}}{\text{Ca O}} = \frac{667}{23} > \frac{7}{1}, \quad \frac{\text{Mg O}}{\text{Fe O}} = \frac{550}{117} < \frac{7}{1} > \frac{5}{3}$$

EXAMPLE II

FELIX

Proc. U. S. Nat. Mus. 1901, 24, 197

	Per Cent.	Mol.	Chromite	Leuc.	Nep.	An.	Tentative Diop.	Tentative Oliv.	Deficit	Ak.	Final Diop.	Final Olv.
SiO_2	33.57	560	..	4	20	40	154	437	95	57	2	437
Al_2O_3	3.24	31	..	1	10	20	..	..	..	..	..	..
Cr_2O_3	.80	5	5	..	..	..	..	..	..	..	..	..
FeO	26.22	364	5	..	..	..	..	..	..	..	..	..
NiO	1.01	13	..	..	..	..	77	875	..	..	1	874
MnO	.68	10	..	..	..	..	..	..	..	..	..	..
MgO	19.74	493	..	..	..	..	..	..	..	..	..	..
CaO	5.45	97	..	..	..	20	77	..	..	76	1	..
Na_2O	.62	10	..	..	10	..	..	..	..	..	..	..
K_2O	.14	1	..	1	..	..	..	..	..	..	..	..
H_2O	.16	..	..	..	..	..	..	..	..	..	..	..
Fe	2.59	..	..	..	..	..	..	..	..	..	..	..
Ni	.36	..	..	..	..	..	..	..	..	..	..	..
Co	.08	..	..	..	..	..	..	..	..	..	..	..
Cu	.01	..	..	..	..	..	..	..	..	..	..	..
FeS	4.76	..	..	..	..	..	..	..	..	..	..	..
Graphite	.36	..	..	..	..	..	..	..	..	..	..	..
Sum	99.79	..	..	..	..	..	..	..	..	..	..	..

$$2x + 3y + \frac{z}{2} = 496 = \text{available } SiO_2$$

$$x + 4y \quad = 77 = \text{molecules of } CaO$$

$$x + \quad z = 875 = \text{molecules of } MgO + FeO.$$

Whence, $x = 1$ = diopside, $y = 19$ = akermanite, $z = 874$ = olivine.

Formula	Mol. Wt.			Norm			
$K_2O.Al_2O_3.4SiO_2$	1×436	= leucite	= .44	L	3.28	Sal	8.84
$Na_2O.Al_2O_3.2SiO_2$	10×284	= nephelite	= 2.84				
$CaO.Al_2O_3.2SiO_2$	20×278	= anorthite	= 5.56	F	5.56		
$CaO.SiO_2$	1×116						
$MgO.SiO_2$	5×100	= diopside	= .24	P	.24	Fem	90.24
$FeO.SiO_2$	5×132						
$2MgO.SiO_2$	492×70	= olivine	= 73.40	O	81.08		
$2FeO.SiO_2$	382×102						
$4CaO.3SiO_2$	19×404	= akermanite	= 7.68				
$FeO.Cr_2O_3$	5×224	= chromite	= 1.12	M	1.12		
FeS		= troilite	= 4.76	A	7.80		
Fe_nN_m		nickel-iron	= 3.04				
		H_2O	= .16				
		graphite	= .36				
			99.60				

Perfemic, Persilicic, Perpolic

$$\frac{\text{Sal}}{\text{Fem}} = \frac{8.84}{90.24} < \frac{1}{7}, \quad \frac{\text{POM}}{\text{A}} = \frac{82.44}{7.80} > \frac{7}{1}, \quad \frac{\text{PO}}{\text{M}} = \frac{81.32}{1.12} > \frac{7}{1}$$

Perolic, Permirlic, Permiric

$$\frac{\text{P}}{\text{O}} = \frac{.24}{81.08} < \frac{1}{7}, \quad \frac{CaO + MgO + FeO}{Na_2O} = \frac{977}{10} > \frac{7}{1}, \quad \frac{MgO + FeO}{CaO} = \frac{880}{97} > \frac{7}{1}$$

Magnesiferrous

$$\frac{MgO}{FeO} = \frac{493}{387} < \frac{5}{3} > \frac{3}{5}$$

ALPHABETICAL LIST OF THE STONE METEORITES ANALYSES OF WHICH ARE GIVEN

The numbers refer to the number of the analysis in the following table of analyses

Adare........................ 74
Albareto........................ 27
Alfianello....................92, 111
Allegan........................ 103
Angra dos Reis................ 11
Aussun....................94, 109
Bachmut........................ 69
Beaver Creek................ 95
Bishopville................... 32
Bjurböle...................... 18
Blansko...................... 112
Bluff......................... 55
Borkut........................ 29
Bremervörde.................. 63
Buschhof..................... 114
Busti......................36, 37
Cabezzo de Mayo.............. 118
Cape Girardeau............... 116
Carcote...................... 17
Castalia...................... 71
Chandakapur.................. 21
Chateau Renard............... 56
Cold Bokkeveld............... 121
Constantinople............... 7
Coon Butte................... 39
Cynthiana.................... 53
Dhurmsala.................... 85
Drake Creek.................. 70
Dundrum...................... 72
Eli Elwah.................... 62
Ensisheim.................... 79
Ergheo....................... 44
Estacado..................... 26
Farmington................... 107
Felix........................ 60
Forest City.................. 115
Frankfort.................... 2
Gnadenfrei................... 77
Gopalpur..................... 73
Hendersonville............... 42
Heredia...................... 117
Hessle....................97, 113
Homestead................104, 105
Hvittis...................... 64
Ibbenbühren.................. 33
Jerome....................... 61
Juvinas...................... 1
Kaba......................... 57
Kakova....................... 58
Kernouvé..................... 31
Khetree...................... 102
Klein-Wenden................. 81
Knyahinya.................... 10
Krähenberg...............14, 68
Lesves....................... 15
Linum........................ 13
Lixna........................ 99
Llano del Inca............... 30
Long Island.................. 49
Lumpkin...................... 106
Lundsgard.................... 25
Manbhoom..................... 48
Manegaum..................... 34
Marion....................... 93
Marjalahti................... 125
Mässing...................... 3
Mauerkirchen.............45, 110
Meuselbach................... 24
Mezö-Madaras................. 22
Middlesborough............... 41
Mincy........................ 124
Mocs......................... 65
Modoc........................ 67
Mount Vernon................. 122
Nerft........................ 19
New Concord..............46, 50
Ngawi........................ 40
Nowo-Urei.................... 52
Ogi.......................... 98
Orgueil...................... 78
Ornans....................... 120
Orvinio...................... 80

Parnallee	16
Peramiho	5
Petersburg	4
Pickens County	28
Pultusk	82, 101
Rakowka	20
Richmond	86
Rochester	84
St. Christophe	89
St. Denis-Westrem	88
St. Mark's	66
Saline	96
Salt Lake City	100
Searsmont	83
Shalka	35, 38
Shelburne	91
Shergotty	8
Shytal	119
Sokobanja	47
Ställdalen	76
Stannern	6
Stawropol	12
Steinbach	123
Tadjera	90
Tieschitz	87
Tokeuchimura	75
Tourinnes-la-Grosse	23
Travis County	43
Uden	9
Utrecht	108
Waconda	54
Warrenton	59
Zavid	51

In some cases different analyses of the same meteorite require it to be placed in more than one group. Such cases indicate that further analyses are needed. In Busti for example there seems to be no way of determining whether Dancer's or Maskelyne's analysis is the more nearly correct and both must be used, but further analyses would probably furnish ground for eliminating one or the other. It is quite possible that a similar confusion would appear in terrestrial rocks if analyses of the same rock made at widely different times and by different analysts were compared. While some such discrepancies occur, in most cases plural analyses agree in placing the meteorite in the same group. This is true for example, of Homestead, New Concord, Aussun, Hessle, and others. In such cases the plurality of analyses happily confirms the placing of the meteorite. An opportunity for comparison of the grouping of meteorites in the quantitative classification with that of Rose, Tschermak, and Brezina is afforded by the Brezina symbol of each meteorite given in the tables. Comparison shows that on the whole the important groups of the German classification remain intact in the quantitative classification. Thus the howardities, eukrites, and chladnites occupy on the whole similar and separate places in both classifications. Among the subgroups of the chondrites little similarity of grouping in the two classifications can be noted, though the gray chondrites and spherical chondrites are rather more numerous among the less siliceous groups of the quantitative classification. This would be expected since the color and structure of the meteorites of these groups indicate a larger proportion of olivine than in the white or intermediate chondrites. Such a scattering of these groups, however, on

the whole emphasizes the impossibility of accurately classifying meteorites by their physical characters as has hitherto been attempted by the German system.

An interesting feature of the calculations is the indication which they afford of the presence of leucite or nephelite or both in some meteorites, such as Felix, Shytal, and Cold Bokkeveld. The calculation of these minerals was required by the low percentage of silica and suggests that a careful examination of the meteorites for these minerals, which have not been hitherto observed in meteorites, should be made. The most common meteorite type is seen from the tables to be that of Pultusk, perfemic, dosilicic, perpolic, pyrolic, permirlic, permiric, and domagnesic.

The Farmington type is also largely represented, differing from Pultusk only in being domolic instead of pyrolic. Further it will be seen by examining the tables that the great majority of meteorites are domagnesic and in making the calculations it was found that a proportion of Mg O to Fe O of very nearly 4:1 was highly preponderant and characteristic.

A summation of all the analyses, 125 in number, should give a fair average of the composition of stone meteorites. It gives the following result:

AVERAGE COMPOSITION OF STONE METEORITES

SiO_2	39.12
Al_2O_3	2.62
Fe_2O_3	.38
Cr_2O_3	.41
FeO	16.13
MnO	.18
NiO	.21
MgO	22.42
CaO	2.31
Na_2O	.81
K_2O	.20
H_2O	.20
Fe	11.46
Ni	1.15
Co	.05
S	1.98
P	.04
P_2O_5	.03
C	.06
Ni, Mn, Cu, Sn	.02
TiO_2	.02
SnO_2	.02
	99.82

The results agree very nearly with those obtained by Merrill* by the addition of 99 analyses, the principal difference being a larger percentage of Ca O in the present writer's result. The present writer's method of determining the minor constituents differed from that of Merrill in that the present writer divided the totals of these constituents by the total number of analyses instead of by the number of analyses in which each constituent was reported. It is evident that the writer's method will produce too low a result, but the other method may give one too high, since the minor constituents may have been lacking in analyses in which they were not reported. It may further be suggested by way of discussion of the interesting comparison made by Merrill between stony meteorites and the earth's crust, that only the lighter and more siliceous meteorites should be used for such a comparison. Stony meteorites having large percentages of free metal have too high a specific gravity to be strictly comparable with the earth's crust. Again it should be recognized that the greater abundance of certain elements at the surface of the earth may be on account of their greater solubility. Thus limestones have grown successively more calcic and less magnesian since early times and an increase in the amount of soda and potash at the surface might take place in the same way. It does not appear that such a process would explain the discrepancy in the amount of alumina but it might act to increase the amount of silica. That the earth's crust of earlier times was more nearly meteoritic in composition than the present seems to be indicated by the great deposits of iron oxide of earlier ages and the fact that the early limestones are more magnesian than the modern.

Adding the analyses of iron meteorites p. 229 to those previously published, and omitting about 60 obviously imperfect ones, 318 analyses are obtained from which the average composition of iron meteorites can be calculated by summation. This sum is as follows:

AVERAGE COMPOSITION OF IRON METEORITES

Fe	90.85
Ni	8.52
Co	.59
P	.17
S	.04
C	.03
Cu	.02
Cr	.01
	100.23

* Am. Jour. Sci. 1909, 4. 27, 471.

Combining this sum with that previously obtained from 125 analyses of stone meteorites, stone meteorites being here regarded as all those which have an appreciable quantity of silicates, the sum total gives according to Clarke's method* the average composition of meteorites as a whole. The method is, of course, empirical, but seems to be the only one available in our present state of knowledge. This sum is the following:

AVERAGE COMPOSITION OF METEORITES

Fe	68.43
$Si\,O_2$	11.07
Ni	6.44
Mg O	6.33
Fe O	4.55
$Al_2\,O_3$	.74
Ca O	.65
S	.49
Co	.44
$Na_2\,O$	.23
P	.14
$Cr_2\,O_3$	.12
$Fe_2\,O_3$	.11
Ni O	.06
$K_2\,O$	.05
Mn O	.04
C	.04
Cu	.01
Cr	.01
$P_2\,O_5$	.01
$Ti\,O_2$	.01
$Sn\,O_2$	.01
	99.98

The present writer has previously suggested,† that the average composition of meteorites may represent the composition of the earth as a whole. If so the proportions of the elements in the earth as a whole would be as follows:

PROPORTION OF ELEMENTS IN THE EARTH AS A WHOLE AS DEDUCED FROM METEORITES

Iron	72.06
Oxygen	10.10
Nickel	6.50
Silicon	5.20

* Bull. U. S. Geol. Survey, 1891, 78, 33.
† Jour. Geol. 1901, 9, 630.

Magnesium	3.80
Sulphur	.49
Calcium	.46
Cobalt	.44
Aluminum	.39
Sodium	.17
Phosphorus	.14
Chromium	.09
Potassium	.04
Carbon	.04
Manganese	.03
Other elements	.05
	100.00

The large proportion of iron in the constitution of the earth indicated by meteorites is in accord with the earth's density, rigidity, and magnetic proportions. Assuming the density of the rocks of the earth's crust to be 2.8, which may be too high, and combining with it metal of the density of 7.8, which is an average of the density of iron meteorites, it will be found that 77.58 per cent of metal will be required to obtain a density of 5.57, that of the earth as a whole. This is very nearly that of the sum of the metals in the above result after eliminating the proportions present as oxides. Such a proportion of iron would seem to be in accord, as has been stated, with the earth's rigidity and magnetic properties.

SYNOPSIS OF METEORITE CLASSIFICATION

CLASS III. $\frac{Sal}{Fem} < \frac{5}{3} > \frac{3}{5}$

SALFEMIC

SUBCLASS I. $\frac{QFL}{CZ} > \frac{7}{1}$

PERQUARFELIC

Order	1. $\frac{Q}{F} > \frac{7}{1}$ Perquaric	2. $\frac{Q}{F} < \frac{7}{1} > \frac{5}{3}$ Doquaric	3. $\frac{Q}{F} < \frac{5}{3} > \frac{3}{5}$ Quarfelic	4. $\frac{Q}{F} < \frac{3}{5} > \frac{1}{7}$ Quardofelic	5. $\frac{QL}{F} < \frac{1}{7}$ Perfelic
Rang 1. Peralkalic, $\frac{K_2O+Na_2O}{CaO} > \frac{7}{1}$					
Rang 2. Domalkalic, $\frac{K_2O+Na_2O}{CaO} < \frac{7}{1} > \frac{5}{3}$					
Rang 3. Alkalicalcic, $\frac{K_2O+Na_2O}{CaO} < \frac{5}{3} > \frac{3}{5}$					
Rang 4. Docalcic, $\frac{K_2O+Na_2O}{CaO} < \frac{3}{5} > \frac{1}{7}$					
Rang 5. Percalcic, $\frac{K_2O+Na_2O}{CaO} < \frac{1}{7}$					Juvinose

CLASS IV. $\frac{Sal}{Fem} < \frac{3}{5} > \frac{1}{7}$

DOFEMIC

SUBCLASS II. $\frac{POM}{A} < \frac{7}{1} > \frac{5}{3}$

DOSILICIC

1. $\frac{P.O}{M} > \frac{7}{1}$

RPOLIC

$< \frac{5}{3} > \frac{3}{5}$ rolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic	1. Pe
lose	Estacadose	Albaretose	

OM $\frac{}{A} < \frac{7}{1} > \frac{5}{3}$

LLIC

$\frac{O}{I} > \frac{7}{1}$

1. $\frac{3}{5}$	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic
	Kernouvose	

CLASS IV. $\frac{Sal}{Fem} < \frac{3}{5} > \frac{1}{7}$

DOFEMIC

	SUBCLASS I. $\frac{POM}{A} > \frac{7}{1}$ PERSILICIC					SUBCLASS II. $\frac{POM}{A} < \frac{7}{1} > \frac{5}{3}$ DOSILICIC								SUBCLASS III. $\frac{POM}{A} < \frac{7}{1} > \frac{5}{3}$ SILICOMETALLIC				
	ORDER 1. $\frac{P.O}{M} > \frac{7}{1}$ PERPOLIC					ORDER 1. $\frac{P.O}{M} > \frac{7}{1}$ PERPOLIC					ORDER 2. $\frac{P.O}{M} < \frac{7}{1} > \frac{5}{3}$ DOPOLIC			ORDER 1. $\frac{P.O}{M} > \frac{7}{1}$ PERPOLIC				
Section	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3, 4 and 5 not represented	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic
Rang I. Permirlic, $\frac{CaO+MgO+FeO}{Na_2O} > \frac{7}{1}$																		
Section 1. Permiric, $\frac{MgO+FeO}{CaO} > \frac{7}{1}$																		
Subrang 1. Permagnesic, $\frac{MgO}{FeO} > \frac{7}{1}$							Linumose					ickensose				Borkutose		
Subrang 2. Domagnesic, $\frac{Mg}{FeO} < \frac{7}{1} > \frac{5}{3}$			Udenose		Stawropolose		Krahenbergose	Parnallose	Estacadose	Albaretose							Kernouvose	
Subrang 3. Magnesiferrous, $\frac{MgO}{FeO} < \frac{5}{3} > \frac{3}{5}$																Incose		
Subrang 4. Doferrous, $\frac{MgO}{FeO} < \frac{3}{5} > \frac{1}{7}$																		
Subrang 5. Perferrous, $\frac{MgO}{FeO} < \frac{1}{7}$																		
Section 2. Domiric, $\frac{MgO+FeO}{CaO} < \frac{7}{1} > \frac{5}{3}$																		
Subrang 1. Permagnesic, $\frac{MgO}{FeO} > \frac{7}{1}$																		
Subrang 2. Domagnesic, $\frac{MgO}{FeO} < \frac{7}{1} > \frac{5}{3}$	Frankfortose																	
Subrang 3. Magnesiferrous, $\frac{MgO}{FeO} < \frac{5}{3} > \frac{3}{5}$	Stannernose	Shergottose																
Section 3. Calcimiric, $\frac{MgO+FeO}{CaO} < \frac{5}{3} > \frac{3}{5}$																		
Subrang 1. Permagnesic, $\frac{MgO}{FeO} > \frac{7}{1}$																		
Subrang 2. Domagnesic, $\frac{MgO}{FeO} < \frac{7}{1} > \frac{5}{3}$			Angrose															
Subrang 3. Magnesiferrous, $\frac{MgO}{FeO} < \frac{5}{3} > \frac{3}{5}$																		
Subrang 4. Doferrous, $\frac{MgO}{FeO} < \frac{3}{5} > \frac{7}{1}$	Constantinoplose																	

CLASS V. $\frac{Sal}{Fem} < \frac{1}{7}$

PERFEMIC

SUB

$\frac{5}{3} > \frac{3}{5}$ …olic	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric
	Hvittisose	
…se	Mocsose	Castaliose
		Ensisheimose

SUBCLASS IV. $\frac{POM}{A} < \frac{3}{5} > \frac{1}{7}$

DOMETALLIC

ORDER 1. $\frac{PO}{M} > \frac{7}{1}$

PERPOLIC

2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3 and 4 not represented	5. $\frac{P}{O} < \frac{1}{7}$ Perolic
		Marjalahtose
Minciose		

CLASS V. $\frac{Sal}{Fem} < \frac{1}{7}$

PERFEMIC

	SUBCLASS I. $\frac{POM}{A} > \frac{7}{1}$ PERSILICIC								SUBCLASS II. $\frac{POM}{A} < \frac{7}{1} > \frac{5}{3}$ DOSILICIC					SUBCLASS III. $\frac{POM}{A} < \frac{5}{3} > \frac{3}{5}$ SILICOMETALLIC	SUBCLASS IV. $\frac{POM}{A} < \frac{3}{5} > \frac{1}{7}$ DOMETALLIC			
	ORDER 1. $\frac{PO}{M} > \frac{7}{1}$ PERPOLIC					ORDER 2. $\frac{PO}{M} < \frac{7}{1} > \frac{5}{3}$ DOPOLIC			ORDER 1. $\frac{PO}{M} > \frac{7}{1}$ PERPOLIC					Not represented	ORDER 1. $\frac{PO}{M} > \frac{7}{1}$ PERPOLIC			
Section	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3. $\frac{P}{O} < \frac{5}{3} > \frac{3}{5}$ Pyrolic	4. $\frac{P}{O} < \frac{3}{5} > \frac{1}{7}$ Domolic	5. $\frac{P}{O} < \frac{1}{7}$ Perolic		1. $\frac{P}{O} > \frac{7}{1}$ Perpyric	2. $\frac{P}{O} < \frac{7}{1} > \frac{5}{3}$ Dopyric	3 and 4 not represented	5. $\frac{P}{O} < \frac{1}{7}$ Perolic
Rang 1. Permirlic, $\frac{CaO + MgO + FeO}{Na_2O} > \frac{7}{1}$																		
Section 1. Permiric, $\frac{MgO + FeO}{CaO} > \frac{7}{1}$																		
Subrang 1. Permagnesic, $\frac{MgO}{FeO} > \frac{7}{1}$	Bishopvillose	×							Hvittisose		Orviniose							Marjalahtose
Subrang 2. Domagnesic, $\frac{MgO}{FeO} < \frac{7}{1} > \frac{5}{3}$	Ibbenbührenose	Shalkose	Travisose	Wacondose	Kakovose			Elwahose	Mocsose	Castaliose	Pultuskose	Farmingtonose	Ornansose		Steinbachose	Minciose		
Subrang 3. Magnesiferrous, $\frac{MgO}{FeO} < \frac{5}{3} > \frac{3}{5}$		Middlesborose	Concordose	Kabose	Jeromose					Ensisheimose	Homesteadose							
Subrang 4. Doferrous, $\frac{MgO}{FeO} < \frac{3}{5} > \frac{1}{7}$																		
Subrang 5. Perferrous, $\frac{MgO}{FeO} < \frac{1}{7}$																		
Section 2. Domiric, $\frac{MgO + FeO}{CaO} < \frac{7}{1} > \frac{5}{3}$																		
Subrang 1. Permagnesic, $\frac{MgO}{FeO} > \frac{7}{1}$	Bustose																	
Subrang 2. Domagnesic, $\frac{MgO}{FeO} < \frac{7}{1} > \frac{5}{3}$																		
Subrang 3. Magnesiferrous, $\frac{MgO}{FeO} < \frac{5}{3} > \frac{3}{5}$																		

Name		Brezina's Symbol	Analyst	Reference
	COSE			
30. Llano del Inca...	*ap* 1.7 *tr* 10.6 *nf* 25.8	M	L. G. Eakins....	Proc. Rochester Acad. Sci. 1890, 1, 94. Mass anal. calc. by Farrington
	OSE			
31. Kernouvé.......	*tr* 6.1 *nf* 23.8	Ck	F. Pisani........	Comptes Rendus, 1869, 68, 1489–1491
	LOSE			
32. Bishopville.....		Chla	J. L. Smith......	Am. Jour. Sci. 1864, 2, 38, 225
	NOSE			
33. Ibbenbühren....		Chl	G. von Rath....	Sitzber. nieder. Gesell. Bonn, 1871, 28, 142–145
34. Manegaum.....	*cm* 1.0	Chl	....	N. S. Maskelyne, Phil. Trans. 1870, 109, 211–213
35. Shalka.........	*cm* 2.2	Chl	C. Rammelsberg	Monatsber. Berlin Akad. 1870, 316–322
	E			
36. Busti..........	*oh* 4.1	Bu	N. S. Maskelyne	Phil. Trans. 1870, 140, 193–211
37. Busti..........		Bu	W. Dancer......	Phil. Trans. 1870, 140, 193–211

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
DOFEMIC, SILICOMETALLIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, INCOSE																			
30. Llano del Inca	26.02	4.70	19.29	8.15	3.45	....	....	23.29	2.38	0.16	FeS 10.61	....	Cr_2O_3 0.20 MnO 0.06 NiO 0.90 P_2O_5 0.70	100.00	...	*an* 12.8 *hy* 27.6 *ap* 1.7 *ol* 22.1 *tr* 10.6 *cm* 0.5 *nf* 25.8	M	L. G. Eakins	Proc. Rochester Acad. Sci. 1890, 1, 94. Mass anal. calc. by Farrington
DOFEMIC, SILICOMETALLIC, PERPOLIC, DOMOLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, KERNOUVOSE																			
31. Kernouvé	32.95	3.19	11.70	23.68	1.89	1.41		22.25	1.55	....	2.15	....		100.77	3.75	*ab* 12.1 *di* 5.8 *tr* 6.1 *an* 2.2 *hy* 2.5 *nf* 23.8 *ol* 47.5	Ck	F. Pisani	Comptes Rendus, 1869, 68, 1489–1491
PERFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, BISHOPVILLOSE																			
32. Bishopville	59.97	....	....	39.34	....	0.74	tr	....	....	....	....	....	Fe_2O_3 0.40 Li_2O tr	100.45	...	*ac* 0.9 *mo* 0.1 *ns* 1.2 *hy* 98.1	Chla	J. L. Smith	Am. Jour. Sci. 1864, 2, 38, 225
PERFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, IBBENBÜHRENOSE																			
33. Ibbenbühren	54.49	1.06	17.34	26.12	1.22	....	....	....	....	....	....	....	MnO 0.28	100.51	3.41	*an* 3.1 *di* 2.3 *hy* 91.7 *ol* 3.5	Chl	G. von Rath	Sitzber. nieder. Gesell. Bonn, 1871, 28, 142–145
34. Manegaum	53.63	....	20.48	23.32	1.40	....	....	....	....	....	....	....	Chromite 1.03	99.95	3.20	*di* 6.1 *cm* 1.0 *hy* 92.9	Chl	....	N. S. Maskelyne, Phil. Trans. 1870, 109, 211–213
35. Shalka	52.64	....	19.78	26.38	0.55	0.40	....	....	....	....	....	....	Cr_2O_3 0.23	99.98	3.41	*ns* 0.7 *cm* 2.2 *di* 2.3 *hy* 85.2 *ol* 11.4	Chl	C. Rammelsberg	Monatsber. Berlin Akad. 1870, 316–322
PERFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, DOMIRIC, PERMAGNESIC, BUSTOSE																			
36. Busti	52.87	....	0.19	28.32	12.40	0.57	0.24	....	....	....	....	....	CaS 4.13 Li_2O 0.02 $CaSO_4$ 0.44	99.18	...	*ks* 0.3 *oh* 4.1 *ns* 1.1 *di* 47.7 *hy* 36.6 *ol* 8.7	Bu	N. S. Maskelyne	Phil. Trans. 1870, 140, 193–211
PERFEMIC, PERSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, PERMAGNESIC																			
37. Busti	52.73	....	4.28	37.22	1.18	....	tr	....	....	....	....	....	NiO 0.78 Na_2S 0.76 MnO 0.01 Apatite tr H_2O 0.92 $CaSO_4$ 1.58 Li_2O tr $CaCl_2$ 0.01	99.47	...	*di* 4.6 *hy* 71.0 *ol* 20.7	Bu	W. Dancer	Phil. Trans. 1870, 140, 193–211

Name	Si		Brezina's Symbol	Analyst	Reference
38. Shalka	52.	m 1.8 r 0.4	Chl	H. B. von Foullon	Ann. Wien. Mus. 1888, 3, 195–208
39. Coon Butte	42.	it 3.7 r 2.2 c 0.8 if 7.7	Cib	J. W. Mallet	Am. Jour. Sci. 1906, 4. 21, 353. Mass anal. calc. by Farrington
		ROSE			
40. Ngawi	42.	m 0.5 r 5.7 if 3.5	Ccn	E. H. von Baumhauer	Arch. Neerland, 1884, 19, 175–185
41. Middlesborough	42.	if 9.4	Cw	W. Flight	Phil. Trans. Roy. Soc. 1882, 3, 885–899. Mass anal. calc. by Farrington
42. Hendersonville	46	m 0.2 r 4.4 if 2.6	Cc	Wirt Tassin	Proc. U. S. Nat. Mus. 1907, 32, 79–82
43. Travis County	44	m 0.7 r 5.0 ip 0.9 if 2.1	Cs	L. G. Eakins	Bull. U. S. Geol. Survey 1891, 78, 91
44. Ergheo	42	r 9.5 if 0.7	Ckb	G. Boeris	Soc. d'Esploraz. Comm. in Africa, Milan 1898, 13
45. Mauerkirchen	41	m 0.7 r 1.9 if 3.8	Cw	F. Crook	Chem. Const. Met. Stones, 26–30
46. New Concord	40	nt 8.4 if 6.0	Cia	A. Madelung	Buchner's Meteoriten 1863, 105
47. Sokobanja	40	r 4.1 if 6.8	Cc	S. M. Losanitch	Ber. Chem. Gesell. Berlin 1878, 11, 96–98. Mass anal. calc. by Wadsworth
48. Manbhoom	40	nt 1.2 m 0.9 r 4.7 c 1.2 if 5.2	Bu	H. B. von Foullon	Ann. Wien. Mus. 1888, 3, 195–208
49. Long Island	35	m 9.4 r 5.2 c 0.4 nf 3.3	Cia	H. W. Nichols	Pubs. Field Col. Mus. Geol. Ser. 1902, 1, 297
		OSE			
50. New Concord	41	r 0.3 if 10.6	Cia	J. L. Smith	Am. Jour. Sci. 1861, 2, 31, 87–98. Mass anal. calc. by Farrington

PERFEMIC, PERSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, SHALKOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
38. Shalka	52.51	0.66	16.81	28.35	0.89	0.22	....	....	....	....	FeS 0.39	tr	Cr_2O_3 1.25	101.08	...	ab 1.6 an 1.1 di 2.7 hy 78.4 ol 15.1 cm 1.8 tr 0.4	Chl	H. B. von Foullon	Ann. Wien. Mus. 1888, 3, 195–208
39. Coon Butte	42.62	1.69	12.98	26.55	0.96	0.40	0.12	7.71	0.93	0.01	FeS 2.15	Fe_3P 0.76	Fe_2O_3 2.60 Chromite 0.08 Cu, Mn, Sn, tr	100.00	3.47	or 0.6 ab 3.1 an 2.8 di 1.5 hy 47.5 ol 29.3 mt 3.7 tr 2.2 sc 0.8 nf 7.7	Cib	J. W. Mallet	Am. Jour. Sci. 1906, 4. 21, 353. Mass anal. calc. by Farrington

PERFEMIC, PERSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, MIDDLESBOROSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
40. Ngawi	42.77	0.78	24.06	15.31	2.63	2.73	0.45	2.87	0.65	tr	FeS 5.71	....	Chromite 0.47 NiO 1.57 MnO tr	100.00	...	or 2.2 ab 2.1 ns 4.9 di 10.6 hy 43.2 ol 27.2 cm 0.5 tr 5.7 nf 3.5	Ccn	E. H. von Baumhauer	Arch. Neerland, 1884, 19, 175–185
41. Middlesborough	42.61	1.75	23.80	20.86	1.60	....	....	7.22	2.00	0.16	....	....		100.00	...	an 4.7 di 2.8 hy 52.2 ol 31.0 nf 9.4	Cw	W. Flight	Phil. Trans. Roy. Soc. 1882, 3, 885–899. Mass anal. calc. by Farrington

PERFEMIC, PERSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, TRAVISOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
42. Hendersonville	46.06	2.20	14.33	28.62	2.13	0.96	0.10	2.37	0.21	0.01	1.61	0.01	Cr_2O_3 0.23 Residue 0.51	99.35	...	or 0.6 ab 8.4 an 1.4 di 7.3 hy 36.5 ol 36.5 cm 0.2 tr 4.4 nf 2.6	Cc	Wirt Tassin	Proc. U. S. Nat. Mus. 1907, 32, 79–82
43. Travis County	44.75	2.72	16.04	27.93	2.23	1.13	0.13	1.83	0.22	0.01	1.83	....	Cr_2O_3 0.52 MnO tr CuO tr H_2O 0.84 P_2O_5 0.41	101.11	3.54	or 0.6 ab 9.4 an 2.0 di 5.1 hy 30.0 ol 44.0 cm 0.7 tr 5.0 ap 0.9 nf 2.1	Cs	L. G. Eakins	Bull. U. S. Geol. Survey 1891, 78, 91
44. Ergheo	42.53	2.23	17.13	26.13	1.08	0.13		0.57	0.17	....	FeS 9.48	....		99.45	3.31	ab 1.1 an 5.6 hy 45.9 ol 36.8 tr 9.5 nf 0.7	Ckb	G. Boeris	Soc. d'Esploraz. Comm. in Africa, Milan 1898, 13
45. Mauerkirchen	41.53	1.71	23.32	24.20	2.12	0.24	0.15	3.75		....	0.70	....		98.44	...	or 0.6 ab 2.1 an 3.3 di 5.9 hy 32.3 ol 47.4 cm 0.7 tr 1.9 nf 3.8	Cw	F. Crook	Chem. Const. Met. Stones, 26–30
46. New Concord	40.39	2.30	18.13	23.51	2.52	....	....	5.78	0.24	....	....	....	Fe_2O_3 5.82 NiO 0.81 Mn tr	99.50	...	an 6.4 di 4.9 hy 40.6 ol 33.2 mt 8.4 nf 6.0	Cia	A. Madelung	Buchner's Meteoriten 1863, 105
47. Sokobanja	40.14	....	25.54	25.78	....	0.26	0.06	....	....	....	1.46	tr		100.21	...	ks 0.2 ns 0.5 hy 41.3 ol 46.6 tr 4.1 nf 6.8	Cc	S. M. Losanitch	Ber. Chem. Gesell. Berlin 1878, 11, 96–98. Mass anal. calc. by Wadsworth
48. Manbhoom	40.12	1.80	20.53	27.30	1.93	0.44	0.20	4.24	0.91	....	1.70	0.20	Fe_2O_3 0 83 Cr_2O_3 0.55 MnO 0.07	100.82	...	or 1.1 ab 3.7 an 2.5 di 5.6 hy 24.8 ol 48.9 mt 1.2 cm 0.0 tr 4.7 sc 1.2 nf 5.2	Bu	H. B. von Foullon	Ann. Wien. Mus. 1888, 3, 195–208
49. Long Island	35.65	3.08	22.85	22.74	1.40	0.25	0.03	2.60	0.67	0.04	1.90	0.06	Cr_2O_3 6.33 NiO 0.77 CoO 0.06 MnO tr H_2O 1.52	99.95	3.45	ab 2.1 an 7.0 C 0.1 hy 27.3 ol 42.3 cm 9.4 tr 5.2 sc 0.4 nf 3.3	Cia	H. W. Nichols	Pubs. Field Col. Mus. Geol. Ser. 1902, 1, 297

PERFEMIC, PERSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, CONCORDOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
50. New Concord	41.73	0.28	24.72	21.64	0.02	0.92		9.23	1.31	0.04	0.11	tr	Cu tr Mn tr	100.00	3.55	ab 1.6 ns 1.5 hy 50.4 ol 35.6 tr 0.3 nf 10.6	Cia	J. L. Smith	Am. Jour. Sci. 1861, 2, 31, 87–98. Mass anal. calc. by Farrington

E

Name		Brezina's Symbol	Analyst	Reference
51. Zavid	tr 2.7 nf 0.2	Cia	C. Hödlmoser	Wiss. Mitth. Bosnia u. Herzegovinia, 1901, 8, 419
52. Nowo-Urei	cm 1.3 tr 0.4 nf 5.5	U	M. Jerofejeff and P. Latschinoff	Verh. d. Russ. Kais. Miner. Ges. 1888, 24, 34 pp.
53. Cynthiana	cm 0.2 tr 5.5 nf 5.9	Cg	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 226. Mass anal. calc. by Wadsworth
54. Waconda	tr 3.9 nf 5.3	Ccb	J. L. Smith	Am. Jour. Sci. 1877, 3, 13, 212. Mass anal. calc. by Farrington
55. Bluff	ap 0.7 tr 3.6 nf 5.7	Ck	J. E. Whitfield	Am. Jour. Sci. 1888, 3, 36, 119

E

56. Chateau Renard	tr 1.1 nf 9.3	Cia	A. Dufrenoy	Comptes Rendus, 1841, 13, 47–53
57. Kaba	cm 0.9 tr 3.6 nf 4.3	K	F. Wohler	Sitzber. Wien. Akad. 1858, 33, 205–209

58. Kakova	cm 0.1 nf 8.5	Cga	E. P. Harris	Chem. Const. Met. 1859, 22–34. Mass anal. calc. by Farrington

SE

59. Warrenton	cm 0.2 tr 3.5 nf 2.0	Cco	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 223. Mass anal. calc. by Farrington
60. Felix	cm 1.1 tr 4.8 nf 3.0	Kc	Peter Fireman	Proc. U. S. Nat. Mus. 1901, 24, 193–198
61. Jerome	cm 0.9 ap 1.0 tr 5.1 nf 4.3	Cck	H. S. Washington	Am. Jour. Sci. 1898, 4, 5, 453

PERFEMIC, PERSILICIC, PERPOLIC, DOMOLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, WACONDOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
51. Zavid	41.90	1.92	27.40	22.79	4.60	1.05	0.41	0.15	....	....	1.01	....	H_2O 0.39	101.11	3.55	*or* 2.2 *ab* 7.9 *ns* 0.2 *di* 18.7 *ol* 68.7 *tr* 2.7 *nf* 0.2	Cia	C. Hödlmoser	Wiss. Mitth. Bosnia u. Herzegovinia, 1901, 8, 419
52. Nowo-Urei	39.51	0.60	13.35	35.80	1.40	....	....	5.25	0.20	....	0.15	0.02	Cr_2O_3 0.05 MnO 0.43 Carbon 1.26 Diamond 1.00	99.92	...	*an* 1.7 *di* 4.2 *hy* 16.7 *ol* 67.2 *cm* 1.3 *tr* 0.4 *nf* 5.5	U	M. Jerofejeff and P. Latschinoff	Verh. d. Russ. Kais. Miner. Ges. 1888, 24, 34 pp.
53. Cynthiana	38.99	0.22	19.73	26.56	2.20	0.49	....	5.36	0.50	0.07	FeS 5.50	....	Cr_2O_3 0.15	99.77	3.41	*ab* 1.1 *ns* 0.7 *di* 8.8 *hy* 23.0 *ol* 54.6 *cm* 0.2 *tr* 5.5 *nf* 5.9	Cg	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 226. Mass anal. calc. by Wadsworth
54. Waconda	38.14	1.02	23.44	26.69	tr	1.05	tr	4.64	0.65	0.05	FeS 3.85	tr	MnO 0.47 Li_2O tr Cu tr	100.00	3.50	*ab* 5.2 *ns* 1.1 *hy* 14.9 *ol* 69.7 *tr* 3.9 *nf* 5.3	Ccb	J. L. Smith	Am. Jour. Sci. 1877, 3, 13, 212. Mass anal. calc. by Farrington
55. Bluff	37.70	2.17	23.82	25.94	2.20	....	....	4.41	0.88	0.37	1.30	....	NiO 1.50 P_2O_5 0.25 CoO 0.16 MnO 0.45	101.24	3.51	*an* 6.1 *di* 2.5 *hy* 19.4 *ol* 63.0 *ap* 0.7 *tr* 3.6 *nf* 5.7	Ck	J. E. Whitfield	Am. Jour. Sci. 1888, 3, 36, 119

PERFEMIC, PERSILICIC, PERPOLIC, DOMOLIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, KABOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
56. Chateau Renard	38.13	3.82	29.44	17.67	0.14	0.86	0.27	7.70	1.55	....	0.39			99.97	3.56	*or* 1.7 *ab* 7.3 *an* 0.8 *C* 1.7 *hy* 24.9 *ol* 52.9 *tr* 1.1 *nf* 9.3	Cia	A. Dufrenoy	Comptes Rendus, 1841, 13, 47–53
57. Kaba	34.24	5.38	26.20	22.39	0.66	....	0.30	2.88	1.37	tr	FeS 3.55	tr	Chromite 0.89 MnO 0.05 Cu 0.01 C 0.58	98.50	...	*or* 1.7 *an* 3.3 *C* 3.9 *hy* 15.0 *ol* 65.4 *cm* 0.9 *tr* 3.6 *nf* 4.3	K	F. Wohler	Sitzber. Wien. Akad. 1858, 33, 205–209

PERFEMIC, PERSILICIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, KAKOVOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
58. Kakova	37.97	2.27	22.68	24.98	0.69	1.77	0.52	7.15	1.24	0.09	....	0.01	Chromite 0.07 MnO 0.42 Graphite 0.14	100.00	3.38	*or* 2.8 *ab* 9.4 *ns* 1.2 *di* 0.8 *ol* 76.0 *am* 0.9 *cm* 0.1 *nf* 8.5	Cga	E. P. Harris	Chem. Const. Met. 1859, 22–34. Mass anal. calc. by Farrington

PERFEMIC, PERSILICIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, JEROMOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
59. Warrenton	35.51	0.13	30.17	25.57	1.43	0.23	....	1.79	0.21	....	FeS 3.51	....	Cr_2O_3 0.06 NiO 1.16 CoO 0.23	100.00	3.47	*ab* 0.5 *ns* 0.2 *di* 5.7 *hy* 1.9 *ol* 85.4 *cm* 0.2 *tr* 3.5 *nf* 2.0	Cco	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 223. Mass anal. calc. by Farrington
60. Felix	33.57	3.24	26.22	19.74	5.45	0.62	0.14	2.59	0.36	0.08	FeS 4.76	....	Cr_2O_3 0.80 H_2O 0.16 NiO 1.01 CuO 0.01 MnO 0.68 Graphite 0.36	99.79	3.78	*lc* 0.4 *ne* 2.8 *an* 5.6 *di* 0.2 *ol* 73.4 *am* 7.7 *cm* 1.1 *tr* 4.8 *nf* 3.0	Kc	Peter Fireman	Proc. U. S. Nat. Mus. 1901, 24, 193–198
61. Jerome	33.11	1.77	27.97	21.59	1.31	0.65	0.28	3.81	0.43	0.01	1.88	....	Cr_2O_3 0.58 P_2O_5 0.37 NiO 1.77 H_2O 3.03	98.56	3.47	*or* 1.7 *ab* 5.8 *an* 1.1 *di* 2.3 *ol* 72.7 *cm* 0.9 *ap* 1.0 *tr* 5.1 *nf* 4.3	Cck	H. S. Washington	Am. Jour. Sci. 1898, 4, 5, 453

SE

Name		Brezina's Symbol	Analyst	Reference
62. Eli Elwah......	mt 13.5 tr 6.3 sc 0.6 nf 1.0	C	A. Liversidge.....	Proc. Roy. Soc. New South Wales, 1903, 341–359

SE

Name		Brezina's Symbol	Analyst	Reference
63. Bremervörde...	cm 0.3 nf 23.5	Ccb	F. Wohler.......	Ann. Chem. Pharm. 1856, 99, 244–248
64. Hvittis........	cm 0.9 tr 9.1 sc 0.6 nf 20.4	Cek	L. H. Borgström.	Die Meteoriten von Hvittis u. Marjalahti, Helsingiors 1903, 24

E

Name		Brezina's Symbol	Analyst	Reference
65. Mocs.........	cm 1.6 tr 7.1 sc 2.6 nf 9.9	Cwa	F. Koch........	Min. Mitth. 1883, 2, 5, 243
66. St. Mark's.....	tr 14.2 sc 0.4 oh 0.2 nf 19.4	Ck	E. Cohen.......	Ann. South African Mus. 1906, 5, 1–16

SE

Name		Brezina's Symbol	Analyst	Reference
67. Modoc........	tr 3.8 sc 0.2 nf 7.3	Cwa	Wirt Tassin.....	Am. Jour. Sci. 1906, 4, 21, 359
68. Krähenberg....	tr 6.1 nf 6.9	Cho	G. von Rath....	Ann. Phys. Chem. 1869, 137, 328–336. Mass anal. calc. by Wadsworth
69. Bachmut......	cm 0.8 tr 6.5 nf 10.0	Cw	A. Kuhlberg.....	Archiv. Nat. Liv. Ehst. Kurlands 1867, 1, 4, 132
70. Drake Creek...	cm 2.0 tr 4.9 nf 14.6	Cwa	E. H. Baumhauer	Ann. Phys. Chem. 1845, 66, 498–503
71. Castalia.......	tr 1.2 nf 15.2	Cgb	J. L. Smith.....	Am. Jour. Sci. 1875, 3, 10, 147–148
72. Dundrum......	cm 1.5 tr 4.1 nf 20.6	Ck	S. Haughton....	Proc. Roy. Soc. 1866, 15, 214–217. Mass anal. calc. by Wadsworth
73. Gopalpur......	tr 4.8 nf 22.9	Cc	A. Exner.......	Min. Mitth. 1872, 41–43

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
PERFEMIC, PERSILICIC, DOPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, ELWAHOSE																			
62. Eli Elwah	39.47	2.87	17.06	25.58	1.61	0.73	0.11	....	1.01	....	2.30	0.10	Fe_2O_3 9.18	100.02	...	*or* 0.6 *di* 2.9 *mt* 13.5 *ab* 5.8 *hy* 34.6 *tr* 6.3 *an* 4.4 *ol* 29.1 *sc* 0.6 *nf* 1.0	C	A. Liversidge....	Proc. Roy. Soc. New South Wales, 1903, 341–359
PERFEMIC, DOSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, HVITTISOSE																			
63. Bremervörde	45.40	2.34	4.36	22.40	....	1.18	0.37	21.61	1.89	....	....	....	Chromite 0.31 Graphite 0.14	100.00	3.54	*or* 2.2 *hy* 63.7 *cm* 0.3 *ab* 10.0 *ol* 0.3 *nf* 23.5	Ccb	F. Wohler	Ann. Chem. Pharm. 1856, 99, 244–248
64. Hvittis	41.53	1.55	0.34	23.23	1.41	1.26	0.32	24.66	1.96	0.07	3.30	0.08	Cr_2O_3 0.34	100.28	...	*or* 1.7 *ns* 0.9 *cm* 0.9 *ab* 6.8 *di* 5.4 *tr* 9.1 *hy* 52.2 *sc* 0.6 *ol* 2.4 *nf* 20.4	Cek	L. H. Borgström	Die Meteoriten von Hvittis u. Marjalahti, Helsingiors 1903, 24
PERFEMIC, DOSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, MOCSOSE																			
65. Mocs	42.74	tr	20.86	15.95	2.78	1.20	0.21	7.93	1.38	tr	2.61	0.41	Chromite 1.56 Mn 0.57 MnO 1.12 Li_2O tr C 0.19	99.51	3.64	*Q* 3.5 *ks* 0.3 *cm* 1.6 *ns* 2.3 *tr* 7.1 *di* 11.3 *sc* 2.6 *hy* 58.8 *nf* 9.9	Cwa	F. Koch	Min. Mitth. 1883, 2, 5, 243
66. St. Mark's	38.29	0.64	6.50	18.23	1.08	0.85	0.23	26.44	1.84	0.21	5.26	0.05	MnO 0.33 Cl 0.27 Mn 0.29 C 0.36 Ca 0.28	101.15	...	*Q* 1.3 *ns* 1.2 *tr* 14.2 *or* 1.1 *di* 4.5 *sc* 0.4 *ab* 2 1 *hy* 56.0 *oh* 0.2 *nf* 19.4	Ck	E. Cohen	Ann. South African Mus. 1906, 5, 1–16
PERFEMIC, DOSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, CASTALIOSE																			
67. Modoc	44.13	2.47	15.37	26.45	1.74	0.44	tr	6.56	0.68	0.03	1.38	0.05	MnO 0.10	99.40	3.54	*ab* 3.7 *di* 2.9 *tr* 3.8 *an* 5.0 *hy* 47.2 *sc* 0.2 *ol* 28.4 *nf* 7.3	Cwa	Wirt Tassin	Am. Jour. Sci. 1906, 4, 21, 359
68. Krähenberg	41.78	0.06	19.53	24.44	1.94	1.00	....	6.31	0.54	....	2.17	....	Chromite 0. MnO tr	98.68	3.50	*ab* 0.5 *ns* 1.8 *tr* 6.1 *di* 7.0 *nf* 6.9 *hy* 47.0 *ol* 26.8	Cho	G. von Rath	Ann. Phys. Chem. 1869, 137, 328–336. Mass anal. calc. by Wadsworth
69. Bachmut	39.59	2.71	18.81	23.37	0.04	0.63	tr	8.52	1.24	....	2.37	0.05	Chromite 0.79 MnO 0.04 Mn 0.21	98.37	3.56	*ab* 5.2 *hy* 46.2 *cm* 0.8 *C* 1.6 *ol* 26.0 *tr* 6.5 *nf* 10.0	Cw	A. Kuhlberg	Archiv. Nat. Liv. Ehst. Kurlands 1867, 1, 4, 132
70. Drake Creek	38.50	4.81	10.03	22.79	0.70	0.59	0.02	12.82	1.50	0.16	1.80	....	Cr_2O_3 1.37 NiO, CuO, SnO_2 2.53 Cu + Sn 0.07	100.00	...	*ab* 5.2 *hy* 43.1 *cm* 2.0 *an* 3.6 *ol* 23.6 *tr* 4.9 *C* 2.5 *nf* 14.6	Cwa	E. H. Baumhauer	Ann. Phys. Chem. 1845, 66, 498–503
71. Castalia	38.50	2.14	13.31	29.83	....	0.55	tr	14.19	0.96	0.06	0.46	tr	Li_2O tr	100.00	...	*ab* 4.7 *hy* 27.5 *tr* 1.2 *C* 1.2 *ol* 49.9 *nf* 15.2	Cgb	J. L. Smith	Am. Jour. Sci. 1875, 3, 10, 147–148
72. Dundrum	37.80	0.85	7.92	23.33	1.32	0.96	0.50	19.57	1.03	....	FeS 4.05	....	Chromite 1.50 MnO 0.16	98.99	3.32	*or* 0.6 *ns* 1.0 *cm* 1.5 *ab* 4.2 *di* 5.1 *tr* 4.1 *hy* 20.8 *nf* 20.6 *ol* 21.4	Ck	S. Haughton	Proc. Roy. Soc. 1866, 15, 214–217. Mass anal. calc. by Wadsworth
73. Gopalpur	37.44	2.52	11.94	19.72	1.60	0.62	0.21	20.96	1.80	0.10	1.74	....	Cr_2O_3 tr MnO 0.26	98.91		*or* 1.1 *di* 3.6 *tr* 4.8 *ab* 5.2 *hy* 41.9 *nf* 22.9 *an* 3.6 *ol* 15.1	Cc	A. Exner	Min. Mitth. 1872, 41–43

ontinued

Name	Si O_2		Brezina's Symbol	Analyst	Reference
74. Adare	37.2	m 1.8 r 6.5 f 19.1	Cga	R. Apjohn	Jour. Chem. Soc. 1874, 2, 12, 104–106. Mass anal. calc. by Wadsworth
75. Tokeuchimura	36.3	nt 0.7 m 1.6 r 7.6 c 0.6 f 18.5	Ck	Lindner	Ber. Berlin Akad. 1904, 978–983
76. Ställdalen	35.7	m 0.7 p 0.7 r 6.3 f 22.9	Cga	G. Lindström	Öfversigt. Kongl. Veten. Forhan. 1877, 35
77. Gnadenfrei	32.1	m 0.9 r 5.1 f 29.1	Cc	Galle and Lasaulx	Monatsber, Berlin Akad. 1879, 750–771
78. Orgueil	26.0	nt 11.4 m 0.5 r 13.4	K	Pisani	Comptes Rendus 1864, 59, 134

MOSE

Name	Si O_2		Brezina's Symbol	Analyst	Reference
79. Ensisheim	35.6	m 0.7 r 5.6 c 6.2 f 9.2	Ckb	F. Crook	Chem. Const. Met. Stones, 21–26

80. Orvinio	37.4	r 5.5 f 24.8	Co	L. Sipöcz	Sitzber. Wien Akad. 1875, 52, 1, 464
81. Klein-Wenden	33.0	m 0.9 r 5.8 f 26.4	Ck	C. Rammelsberg	Ann. Phys. Chem. 1844, 62, 449–464

82. Pultusk	41.5	m 0.3 r 2.4 f 12.2	Cga	G. von Rath	Neues Jahrb. Min. 1869, 80–82. Mass anal. calc. by Wadsworth
83. Searsmont	40.8	r 3.1 f 14.6	Cc	J. L. Smith	Am. Jour. Sci. 1871, 3, 2, 200. Mass anal. calc. by Farrington
84. Rochester	40.7	m 0.2 r 3.0 f 10.0	Cc	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 222. Mass anal. calc. by Farrington

Name	Si O$_2$	Al$_2$ O$_3$	Fe O	Mg O	Ca O	Na$_2$ O	K$_2$ O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
PERFEMIC, DOSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, CASTALIOSE—*Continued*																			
74. Adare	37.26	2.03	8.95	13.50	3.61	0.79	0.12	16.24	2.73	0.10	Fe S 6.54	....	Chromite 1.75 Mn O 5.50 V tr	99.12	3.93	*or* 0.6 *di* 13.2 *cm* 1.8 *ab* 6.8 *hy* 37.7 *tr* 6.5 *an* 1.7 *ol* 11.8 *nf* 19.1	Cga	R. Apjohn	Jour. Chem. Soc. 1874, 2, 12, 104–106. Mass anal. calc. by Wadsworth
75. Tokeuchimura	36.34	....	14.76	20.91	2.47	1.18	0.28	16.58	1.82	0.05	2.75	0.08	Fe$_2$ O$_3$ 0.36 Mn O 0.16 Cr O 0.42 Ni O 0.30 Chromite 0.95	99.40	3.81	*ks* 0.5 *mt* 0.7 *ns* 2.3 *cm* 1.6 *di* 9.8 *tr* 7.6 *hy* 42.5 *sc* 0.6 *ol* 14.0 *nf* 18.5	Ck	Lindner	Ber. Berlin Akad. 1904, 978–983
76. Ställdalen	35.71	2.11	10.29	23.16	1.61	0.62	0.15	21.10	1.61	0.17	2.27	0.01	Cr$_2$ O$_3$ 0.40 P$_2$ O$_5$ 0.30 Ni O 0.20 Cl 0.04 Mn O 0.25	100.00	3.74	*or* 0.6 *hy* 41.3 *cm* 0.7 *ab* 5.2 *ol* 20.3 *ap* 0.7 *an* 1.1 *tr* 6.3 *C* 1.0 *nf* 22.9	Cga	G. Lindström	Öfversigt. Kongl. Veten. Forhan. 1877, 35
77. Gnadenfrei	32.11	1.60	14.88	17.03	2.01	0.70	....	25.16	3.92	tr	1.87	....	Cr$_2$ O$_3$ 0.57 Mn O tr P$_2$ O$_5$ tr	99.85	3.71	*ab* 5.8 *di* 7.0 *cm* 0.9 *an* 1.4 *hy* 27.5 *tr* 5.1 *ol* 22.4 *nf* 29.1	Cc	Galle and Lasaulx	Monatsber, Berlin Akad. 1879, 750–771
78. Orgueil	26.08	0.90	15.77	17.00	1.85	2.26	0.19	....	....	....	Fe S 13.43	....	Fe$_2$ O$_3$ 7.78 Chromite 0.49 Mn O 0.36 H$_2$ O and org. matter 13.89	100.00	2.50	*or* 1.1 *ns* 3.5 *mt* 11.4 *ab* 3.7 *di* 7.5 *cm* 0.5 *hy* 0.5 *tr* 13.4 *ol* 44.6	K	Pisani	Comptes Rendus 1864, 59, 134
PERFEMIC, DOSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, ENSISHEIMOSE																			
79. Ensisheim	35.65	2.31	34.19	13.13	1.78	0.38	0.22	8.00	1.23	....	2.05	1.01	Cr$_2$ O$_3$ 0.41 Mn O 0.21	99.57	3.50	*or* 1.1 *di* 3.9 *cm* 0.7 *ab* 3.1 *hy* 38.8 *tr* 5.6 *an* 4.2 *ol* 25.2 *sc* 6.2 *nf* 9.2	Ckb	F. Crook	Chem. Const. Met. Stones, 21–26
PERFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, ORVINIOSE																			
80. Orvinio	37.42	2.27	7.98	22.90	2.32	1.21	0.29	22.23	2.60	....	1.99	....		101.19	3.64	*or* 1.7 *di* 8.7 *tr* 5.5 *ab* 10.0 *hy* 24.6 *nf* 24.8 *an* 0.3 *ol* 24.7	Co	L. Sipöcz	Sitzber. Wien Akad. 1875, 52, 1, 464
81. Klein-Wenden	33.03	3.75	6.90	23.64	2.83	0.28	0.38	23.90	2.37	....	2.09	0.02	Cr$_2$ O$_3$ 0.62 Mn O 0.07 Sn 0.08	100.01	3.70	*or* 2.2 *di* 4.8 *cm* 0.9 *ab* 2.1 *hy* 20.9 *tr* 5.8 *an* 8.1 *ol* 27.8 *nf* 26.4	Ck	C. Rammelsberg	Ann. Phys. Chem. 1844, 62, 449–464
PERFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, PULTUSKOSE																			
82. Pultusk	41.54	1.17	14.04	26.73	0.28	1.34	....	11.51	0.65	....	0.87	tr	Chromite 0.29 Mn O 0.49 Insol. 0.04	99.01	3.66	*ab* 6.3 *ns* 1.2 *cm* 0.3 *di* 1.1 *tr* 2.4 *hy* 38.6 *nf* 12.2 *ol* 36.5	Cga	G. von Rath	Neues Jahrb. Min. 1869, 80–82. Mass anal. calc. by Wadsworth
83. Searsmont	40.82	0.81	13.84	25.99	....	0.85		13.24	1.33	0.06	Fe S 3.06	....	Chromite tr Li$_2$ O tr	100.00	3.70	*ab* .2 *ns* 0.7 *tr* 3.1 *hy* 44.0 *nf* 14.6 *ol* 33.4	Cc	J. L. Smith	Am. Jour. Sci. 1871, 3, 2, 200. Mass anal. calc. by Farrington
84. Rochester	40.77	0.10	16.52	26.47	2.43	0.58	....	9.52	0.42	0.05	Fe S 2.99	....	Chromite 0.15	100.00	3.55	*ab* 0.5 *ns* 1.0 *cm* 0.2 *di* 9.6 *tr* 3.0 *hy* 33.6 *nf* 10.0 *ol* 42.1	Cc	J. L. Smith	Am. Jour. Sci. 1877, 3, 14, 222. Mass anal. calc. by Farrington

COMPI ATIVE CLASSIFICATION

Name	Si C		Brezina's Symbol	Analyst	Reference
1. Juvinas...........	49.2		Eu	C. Rammelsberg	Ann. Phys. Chem. 1848, 77, 585–590
		SE			
2. Frankfort.........	51.3	n 0.7 0.6	Ho	G. J. Brush and W. J. Mixter	Am. Jour. Sci. 1869, 2, 48, 243
		OSE			
3. Mässing..........	53.1	n 1.6 1.1 0.6	Ho	A. Schwager.....	Sitzber. München Akad. 1878, 8, 32–40
4. Petersburg........	49.2	0.2 0.5	Ho	J. L. Smith	Am. Jour. Sci. 1861, 2, 31, 265
5. Peramiho.........	49.3	0.8 0.6	Eu	E. Ludwig......	Sitzber. Wien Akad. 1903, 112, 739–777
6. Stannern.........	48.3	0.5	Eu	C. Rammelsberg	Ann. Phys. Chem. 1851, 83, 591–593
		LOSE			
7. Constantinople....	48.59		Eu	G. Tschermak...	Min. Mitth. 1872, 2, 85
		SE			
8. Shergotty.........	50.21		She	E. Lumpe.......	Min. Mitth. 1871, 55–56

ANALYSES OF STONE METEORITES

COMPILED AND CLASSIFIED ACCORDING TO THE PRINCIPLES OF THE AMERICAN QUANTITATIVE CLASSIFICATION

CLASS III

SALFEMIC, PERQUARFELIC, PERFELIC, PERCALCIC, JUVINOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
1. Juvinas	49.23	12.55	20.33	6.44	10.23	0.63	0.12	0.16	....	....	0.09	....	Fe_2O_3 1.21 TiO_2 0.10 Cr_2O_3 0.24 P_2O_5 0.28	101.61	3.12	*Q* 2.2 *di* 14.4 *or* 0.6 *hy* 44.2 *ab* 5.2 *mt* 1.9 *an* 31.1	Eu	C. Rammelsberg	Ann. Phys. Chem. 1848, 77, 585–590

CLASS IV

DOFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, DOMIRIC, DOMAGNESIC, FRANKFORTOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
2. Frankfort	51.33	8.05	13.70	17.59	7.03	0.45	0.22	tr	tr	....	0.23	....	Cr_2O_3 0.42	99.02	3.31	*or* 1.1 *di* 12.4 *cm* 0.7 *ab* 3.7 *hy* 59.4 *tr* 0.6 *an* 19.5 *ol* 6.3	Ho	G. J. Brush and W. J. Mixter	Am. Jour. Sci. 1869, 2, 48, 243

DOFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, DOMIRIC, MAGNESIFERROUS, STANNERNOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
3. Mässing	53.12	8.20	19.14	8.48	5.79	1.93	1.19	0.52	....	....	0.37	....	Cr_2O_3 0.98	99.72	3.36	*Q* 1.3 *di* 15.9 *cm* 1.6 *or* 7.2 *hy* 45.8 *tr* 1.1 *ab* 16.2 *nj* 0.6 *an* 10.0	Ho	A. Schwager	Sitzber. München Akad. 1878, 8, 32–40
4. Petersburg	49.21	11.05	20.41	8.13	9.01	0.82	....	0.50	tr	....	0.06	....		99.23	3.20	*Q* 0.1 *di* 15.5 *tr* 0.2 *ab* 6.8 *hy* 49.5 *nj* 0.5 *an* 26.4	Ho	J. L. Smith	Am. Jour. Sci. 1861, 2, 31, 265
5. Peramiho	49.32	11.24	20.65	7.15	10.84	0.40	0.25	....	....	....	0.23	....	TiO_2 0.42	100.50		*Q* 1.2 *di* 21.7 *il* 0.8 *or* 1.7 *hy* 43.3 *tr* 0.6 *ab* 3.1 *an* 28.1	Eu	E. Ludwig	Sitzber. Wien Akad. 1903, 112, 739–777
6. Stannern	48.30	12.65	19.32	6.87	11.27	0.62	0.23	....	....	....	tr	....	Chromite 0.54 MnO 0.81	100.61	3.05	*or* 1.1 *d* 20.9 *cm* 0.5 *ab* 5.2 *hy* 35.9 *an* 31.1 *ol* 5.6	Eu	C. Rammelsberg	Ann. Phys. Chem. 1851, 83, 591–593

DOFEMIC, PERSILICIC, PERPOLIC, PERPYRIC, PERMIRLIC, CALCIMIRIC, DOFERROUS, CONSTANTINOPLOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
7. Constantinople	48.59	12.63	20.99	6.16	10.39	0.46	0.16	....	....	....	....	....	Cr_2O_3 0.44 MnO tr	99.82		*Q* 0.5 *di* 16.8 *or* 1.1 *hy* 45.3 *ab* 3.7 *cm* 0.4 *an* 32.0	Eu	G. Tschermak	Min. Mitth. 1872, 2, 85

DOFEMIC, PERSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, DOMIRIC, MAGNESIFERROUS, SHERGOTTOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
8. Shergotty	50.21	5.90	21.85	10.00	10.41	1.28	0.57	....	....	....	....	....		100.22		*or* 3.3 *di* 36.2 *ab* 11.0 *hy* 24.5 *an* 8.6 *ol* 16.7	She	E. Lumpe	Min. Mitth. 1871, 55–56

Name			Brezina's Symbol	Analyst	Reference
9. Uden	4	cm 0.8 tr 0.7 nf 1.8	Cwb	Baumhauer and Seelheim	Ann. Phys. Chem. 1862, 116, 185–188
10. Knyahinya	4	cm 0.8 tr 2.2 nf 5.0	Cg	E. H. von Baumhauer	Arch. Neerland, 1872, 7, 146–153, Mass anal. calc. by Wadsworth
11. Angra dos Reis	4	mt 0.5 ap 0.3 tr 1.3 nf 0.8	Angrite	Ludwig and Tschermak	Min. u. petr. Mitth. N. F. 1909, 28, 113
		OSE			
12. Stawropol	3	tr 4.4 nf 4.3	Ck	H. Abich	Bull. Akad. St. Petersburg, 1860, 1862, 403–422, 433–439
13. Linum	4	cm 0.5 tr 1.5 oh 2.9 nf 16.5	Cw	Lindner	Sitzber, Berlin Akad. 1904, 114–153
		E			
14. Krähenberg	4	cm 1.3 tr 6.4 nf 11.7	Cho	Keller	Sitzber, München Akad. 1878, 8, 47–58
		E			
15. Lesves	3	cm 1.6 tr 6.2 nf 13.8	Cw	A. F. Renard	Bull. de l'Acad. roy. de Belgique, 1896, 3, 31, 654–663
16. Parnallee	3	tr 7.4 nf 10.8	Cga	E. Pfeiffer	Sitzber, Wien. Akad. 1863, 47, 2, 460–463
17. Carcote	3	cm 1.4 tr 6.0 nf 10.1	Ck	Will	Neues Jahrb. 1889, 2, 177–179, Mass anal. calc. by Farrington

DOFEMIC, PERSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, UDENOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
9. Uden	44.58	4.10	22.41	20.67	2.28	0.94	0.49	1.77			Fe S 0.72		Chromite 0.76 Mu O 0.43 Ni O 0.29	99.44	3.40	*or* 2.8 *di* 4.8 *cm* 0.8 *ab* 7.9 *hy* 29.7 *tr* 0.7 *an* 5.6 *ol* 45.4 *nf* 1.8	Cwb	Baumhauer and Seelheim	Ann. Phys. Chem. 1862, 116, 185–188
10. Knyahinya	44.30	3.06	16.38	22.16	2.73	1.00	0.66	5.00			Fe S 2.22		Chromite 0.80	98.31	3.52	*or* 3.9 *di* 9.5 *cm* 0.8 *ab* 8.4 *hy* 28.9 *tr* 2.2 *an* 2.0 *ol* 37.6 *nf* 5.0	Cg	E. H. von Baumhauer	Arch. Neerland, 1872, 7, 146–153. Mass anal. calc. by Wadsworth

DOFEMIC, PERSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, CALCIMIRIC, DOMAGNESIC, ANGROSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
11. Angra dos Reis	43.94	8.73	8.28	10.05	24.51	0.26	0.19	0.81	....	....	0.45	....	Fe_2O_3 0.31 TiO_2 2.39 P_2O_5 0.13	100.05	...	*lc* 0.9 *di* 35.1 *mt* 0.5 *ne* 1.1 *ol* 15.7 *ap* 0.3 *an* 22.0 *am* 20.2 *tr* 1.3 *nf* 0.8	Angrite	Ludwig and Tschermak	Min. u. petr. Mitth. N. F. 1909, 28, 113

DOFEMIC, PERSILICIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, STAWROPOLOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
12. Stawropol	33.16	4.22	18.59	29.24	1.20	1.40	0.60	4.32	....	....	1.60	....	Ni O 3.81 SnO_2 1.10	99.24	3.59	*lc* 2.6 *ol* 71.0 *tr* 4.4 *ne* 6.5 *am* 0.8 *nf* 4.3 *an* 3.3 *mo* 4.3	Ck	H. Abich	Bull. Akad. St. Petersburg, 1860, 1862, 403–422, 433–430

DOFEMIC, DOSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, LINUMOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
13. Linum	43.05	2.44	1.32	25.72	3.49	1.39	0.26	15.83	0.71	....	1.85	0.07	Cr_2O_3 0.31 Mn O 0.20 H_2O 0.12 Fe S 3.23	99.99	3.54	*or* 1.6 *ns* 0.2 *cm* 0.5 *ab* 11.0 *di* 5.0 *tr* 1.5 *hy* 43.0 *oh* 2.9 *ol* 13.3 *nf* 16.5	Cw	Lindner	Sitzber, Berlin Akad. 1904, 114–153

DOFEMIC, DOSILICIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, KRÄHENBERGOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
14. Krähenberg	41.12	3.22	17.42	18.62	2.06	0.17	1.22	10.37	1.36	....	2.35	0.46	Cr_2O_3 0.89 Mn O 0.78 SnO_2 0.18	100.22	...	*or* 7.2 *di* 4.9 *cm* 1.3 *ab* 1.6 *hy* 44.8 *tr* 6.4 *an* 4.2 *ol* 16.2 *nf* 11.7	Cho	Keller	Sitzber, München Akad. 1878, 8, 47–58

DOFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, PARNALLOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
15. Lesves	39.46	3.33	15.82	22.75	1.54	1.05	0.09	12.36	1.37	0.11	2.25	....	Cr_2O_3 1.02	101.15	3.58	*or* 0.6 *di* 3.1 *cm* 1.6 *ab* 8.9 *hy* 30.9 *tr* 6.2 *an* 3.9 *ol* 31.0 *nf* 13.8	Cw	A. F. Renard	Bull. de l'Acad. roy. de Belgique, 1896, 3, 31, 654–663
16. Parnallee	39.41	2.57	15.28	22.82	0.56	1.91	0.55	9.83	0.90	0.06	2.71	0.10	Mn O 0.54 H_2O 0.68 Ni O 0.72 Co O 0.06	98.70	3.12	*or* 2.8 *ns* 1.3 *tr* 7.4 *ab* 10.5 *di* 2.2 *nf* 10.8 *hy* 25.8 *ol* 34.5	Cga	E. Pfeiffer	Sitzber, Wien. Akad. 1863, 47, 2, 460–463
17. Carcote	39.28	2.39	14.29	22.79	1.19	1.40	0.30	8.95	0.91		Fe S 5.98	0.21	Chromite 1.43 Cu+Sn 0.06 Mn 0.14 C 0.19 Res 0.49	100.00	3.47	*or* 1.7 *ns* 0.2 *cm* 1.4 *ab* 11.0 *di* 4.7 *tr* 6.0 *hy* 22.3 *nf* 10.1 *ol* 40.4	Ck	Will	Neues Jahrb. 1889, 2, 177–179. Mass anal. calc. by Farrington

Name	Si O_2		Brezina's Symbol	Analyst	Reference
18. Bjurböle..........	41.0	m 0.9 5.4 f 7.1	Cca	Ramsay and Borgström....	Bull. Com. Geol. de Finland, 1902, 12, 13
19. Nerft............	40.0	m 0.7 5.5 f 9.8	Cia	A. Kuhlberg.....	Ann. Phys. Chem. 1869 136, 448–449
20. Rakowka.........	38.8	m 0.8 0.8 6.2 f 7.4	Ci	P. Grigorieux....	Zeitschr. deutsch. Geol. Gesell. 1880, 32, 417–420
21. Chandakapur.....	38.0	t 0.3 m 0.5 1.1 4.9 f 5.8	Cib	H. E. Clarke....	Min. Mag. 1910, 15, 371
22. Mezö-Madaras....	37.6	m 0.7 6.3 f 13.8	Cgb	C. Rammelsberg.	Zeitschr. deutsch. Geol. Gesell. 1871, 23, 734–737, Mass anal. calc. by Wadsworth
23. Tourinnes-la-Grosse	37.4	m 0.7 6.1 f 12.5	Cw	F. Pisani........	Comptes Rendus, 1864, 58, 169–171
24. Meuselbach.......	37.3	m 0.3 7.8 f 7.9	Ccka	G. Linck........	Ann. Wien. Mus. 1899, 13, 103–114, Mass anal. calc. by Farrington
25. Lundsgård........	36.9	m 0.9 6.5 0.6 f 16.4	Cw	O. Nordenskjöld.	Geol. Foren. i. Stockholm, Förh. 1891, 13, 470–475
26. Estacado.........	35.8	3.8 1.0 f 16.4	Ckb	J. M. Davison...	Am. Jour. Sci. 1906, 3, 22, 59
27. Albareto..........	35.91	6.5 f 5.2	Cc	P. Maissen......	Gazetta Chimica, 1880, 10, 20
28. Pickens County...	37.0	nt 15.5 l 0.2 p 0.7 4.3 f 9.6	....	E. Everhart.....	Science, 1909, N. S. 30, 772
		OSE			
29. Borkut...........	35.2	m 0.6 2.5 f 29.7	Cc	J. Nuricsany....	Sitzb. Wien. Akad. 1856, 20, 308–406. Mass anal. calc. by Wadsworth

ANALYSES OF STONE METEORITES—*Continued*

DOFEMIC, DOSILICIC, PERPOLIC, DOMOLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, ESTACADOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
18. Bjurböle	41.06	2.55	13.80	25.75	1.82	1.24	0.32	6.38	0.72	0.04	FeS 5.44	0.14	Cr_2O_3 0.59 MnO 0.12 NiO 0.07	100.04	...	*or* 1.7 *di* 6.3 *cm* 0.9 *ab* 10.5 *hy* 18.4 *tr* 5.4 *an* 0.6 *ol* 47.8 *nf* 7.1	Cca	Ramsay and Borgström	Bull. Com. Geol. de Finland, 1902, 12, 13
19. Nerft	40.00	3.52	15.98	25.59	0.05	1.65	0.08	8.36	1.32	tr	2.02	0.05	Chromite 0.65 MnO 0.03 Mn 0.10	99.40	...	*or* 0.6 *hy* 21.1 *cm* 0.7 *ab* 14.1 *ol* 45.2 *tr* 5.5 *an* 0.3 *nf* 9.8 *C* 0.5	Cia	A. Kuhlberg	Ann. Phys. Chem. 1869 136, 448–449
20. Rakowka	38.87	2.66	13.44	24.60	2.36	2.04	0.37	5.67	1.43	0.32	FeS 6.16	0.12	C 0.13 Mn tr	99.22	3.58	*or* 2.2 *ns* 1.3 *cm* 0.8 *ab* 11.5 *di* 9.4 *sc* 0.8 *hy* 5.2 *tr* 6.2 *ol* 54.0 *nf* 7.4	Ci	P. Grigorieux	Zeitschr. deutsch. Geol. Gesell. 1880, 32, 417–420
21. Chandakapur	38.02	4.17	19.81	21.31	2.42	1.26	0.29	5.25	0.55		FeS 4.92	Fe_3P 1.06	Chromite 0.51 NiO 0.07	99.94	...	*or* 1.7 *di* 5.7 *mt* 0.3 *ab* 10.5 *hy* 4.0 *cm* 0.5 *an* 5.0 *ol* 60.5 *sc* 1.1 *tr* 4.9 *nf* 5.8	Cib	H. E. Clarke	Min. Mag. 1910, 15, 371
22. Mezö-Madaras	37.64	3.41	15.44	24.11	1.68	1.76	tr	12.12	1.64	....	2.27	....	Chromite 0.54 MnO 0.18 NiO 0.06	100.85	...	*ab* 14.8 *di* 5.6 *cm* 0.7 *an* 1.4 *hy* 8.1 *tr* 6.3 *ol* 49.1 *nf* 13.8	Cgb	C. Rammelsberg	Zeitschr. deutsch. Geol. Gesell. 1871, 23, 734–737, Mass anal. calc. by Wadsworth
23. Tourinnes-la-Grosse	37.47	3.65	13.89	24.40	2.61	2.26		11.05	1.30	....	2.21	....	Chromite 0.71 Sn 0.17	99.72	3.53	*ab* 15.2 *ns* 0.1 *cm* 0.7 *ne* 2.0 *di* 10.2 *tr* 6.1 *ol* 51.9 *nf* 12.5	Cw	F. Pisani	Comptes Rendus, 1864, 58, 169–171
24. Meuselbach	37.30	2.89	16.20	24.55	1.72	1.32	....	6.71	1.07	0.11	FeS 7.79	....	Chromite 0.34 Cn tr	100.00	...	*ab* 11.0 *di* 5.2 *cm* 0.3 *an* 2.0 *hy* 6.1 *tr* 7.8 *ol* 59.7 *nf* 7.9	Ccka	G. Linck	Ann. Wien. Mus. 1899, 13, 103–114, Mass anal. calc. by Farrington
25. Lundsgård	36.97	2.70	13.18	23.79	1.40	1.42	0.43	14.46	1.91	0.02	2.38	0.10	Chromite 0.59 NiO 0.05 H_2O 0.50 Cu 0.04 C 0.02	99.96	3.61	*or* 2.2 *ns* 0.1 *cm* 0.9 *ab* 11.5 *di* 5.5 *tr* 6.5 *hy* 15.8 *sc* 0.6 *ol* 38.4 *nf* 16.4	Cw	O. Nordenskjöld	Geol. Foren. i. Stockholm, Förh. 1891, 13, 470–475
26. Estacado	35.82	3.60	15.53	22.74	2.99	2.07	0.32	14.68	1.60	0.08	1.37	0.15	Cr_2O_3 tr MnO tr TiO_2 tr Cu tr	100.95	3.60	*or* 1.7 *ns* 0.1 *il* 3.8 *ab* 9.4 *di* 12.0 *sc* 1.0 *ne* 4.0 *ol* 51.5 *nf* 16.4	Ckb	J. M. Davison	Am. Jour. Sci. 1906, 3, 22, 59

DOFEMIC, DOSILICIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, ALBARETOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
27. Albareto	35.91	4.48	24.31	22.77	2.07	1.64	0.44	4.33	0.73	0.11	2.37	....		99.16	...	*or* 2.2 *di* 5.2 *tr* 6.5 *ab* 5.8 *ol* 64.8 *nf* 5.2 *ne* 4.3 *an* 4.9	Cc	P. Maissen	Gazetta Chimica, 1880, 10, 20

DOFEMIC, DOSILICIC, DOPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, PICKENSOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
28. Pickens County	37.06	5.83	9.63	24.00	0.55	0.92	0.02	8.22	1.23	0.11	1.57	....	Fe_2O_3 10.69 TiO_2 0.09 MnO 0.40 P_2O_5 0.31 CrO 0.36 CuO 0.06	101.05	...	*ab* 7.9 *hy* 42.0 *mt* 15.5 *an* 0.8 *ol* 15.2 *il* 0.2 *C* 4.0 *ap* 0.7 *tr* 4.3 *nf* 9.6	....	E. Everhart	Science, 1909, N. S. 30, 772

DOFEMIC, SILICOMETALLIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, BORKUTOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
29. Borkut	35.28	2.74	4.71	19.92	1.95	1.91	0.66	27.03	1.84		0.89	0.03	Chromite 0.64 Cu + Sn 0.08 Ni + Mn 0.78	98.46	...	*or* 3.9 *ns* 1.3 *cm* 0.6 *ab* 10.0 *di* 7.6 *tr* 2.5 *hy* 20.7 *nf* 20.7 *ol* 21.2	Cc	J. Nuricsany	Sitzb. Wien. Akad. 1856, 20, 308–406. Mass anal. calc. by Wadsworth

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Name	Si O		Brezina's Symbol	Analyst	Reference
Dhurmsala	40.6	4.2 5.6 8.4	Ci	S. Haughton....	Proc. Roy. Soc. 1866, 15, 214–217. Mass anal. calc. by Wadsworth
Richmond	40.3	4.4 8.2	Cck	C. Rammelsberg.	Monatsber. Berlin Akad. 1870, 70, 440
Tieschitz	40.2	4.5 11.6	Cc	J. Habermann...	Denkschr. Wien Akad. 1879, 39, 187–201
St. Denis-Westrem	40.2	1.4 5.8 11.7	Cca	C. Klement.....	Bull. Mus. roy. d'hist. Nat. Belgique 1886, 4, 280
St. Christophe	39.3	0.9 6.9 9.6	Cg	M. A. Lacroix...	Bull. Soc. de'l Onest de la France, 1906, 2, 6, 81–112
Tadjera	39.2	0.2 8.0 8.3	Ct	S. Meunier......	Comptes Rendus 1868, 66, 513–519
Shelburne	39.1	0.9 4.4 0.4 11.5	Cg	L. H. Borgström.	Trans. Roy. Astr. Soc. of Canada 1904
Alfianello	39.1	7.4 12.4	Ci	H. von Foullon..	Sitzber. Wien Akad. 1883, 88, 1, 433
Marion	38.9	6.3 4.6	Cwa	C. Rammelsberg.	Monatsber. Berlin Akad. 1870, 457–459. Mass anal. calc. by Wadsworth
Aussun	38.72	1.8 3.7 2.0 9.6	Cc	H. A. Damour...	Comptes Rendus 1859, 49, 31–36
Beaver Creek	37.43	0.3 0.2 0.3 5.1 17.1	Cck	W. F. Hillebrand	Am. Jour. Sci. 1894, 3, 47, 430. Mass anal. calc. by Farrington
Saline	37.08	6.5 2.0 4.5 0.2 8.9	Cck	H. W. Nichols and E. W. Tillotson	Private contribution
Hessle	36.83	5.1 0.8 22.3	Cc	G. Lindstrom....	Kongl. Svenske. Vet. Ak. 1870
Ogi	36.75	0.6 0.7 5.9 17.4	Cw	T. Shimidzu.....	Trans. Asiatic Soc. Japan 1882, 10, 199–203
Lixna	36.45	0.7 5.9 0.8 19.1	Cga	A. Kuhlberg.....	Archiv. Nat. Liv. Ehst. Kurlands 1867, 1, 4, 1–32

ANALYSES OF STONE METEORITES—*Continued*

PERFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, PULTUSKOSE—*Continued*

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
85. Dhurmsala	40.69	0.60	11.20	26.59	....	0.39	0.21	6.88	1.54	....	Fe S 5.61	....	Chromite 4.16 Mn O 1.26	99.13	3.40	*or* 1.1 *ns* 0.2 *cm* 4.2 *ab* 2.1 *hy* 46.9 *tr* 5.6 *ol* 30.4 *nf* 8.4	Ci	S. Haughton....	Proc. Roy. Soc. 1866, 15, 214–217. Mass anal. calc. by Wadsworth
86. Richmond	40.37	2.21	13.82	28.33	2.68	....	....	8.22		....	Fe S 4.37	....		100.00	3.37	*an* 6.1 *di* 5.6 *tr* 4.4 *hy* 30.2 *nf* 8.2 *ol* 45.5	Cck	C. Rammelsberg.	Monatsber. Berlin Akad. 1870, 70, 440
87. Tieschitz	40.23	1.93	19.80	20.55	1.54	1.53	....	10.26	1.31	....	1.65	....		98.80	3.59	*ab* 9.9 *ns* 0.6 *tr* 4.5 *di* 6.3 *nf* 11.6 *hy* 30.9 *ol* 34.1	Cc	J. Habermann...	Denkschr. Wien Akad. 1879, 39, 187–201
88. St. Denis-Westrem	40.20	2.54	16.22	25.08	2.00	0.99	tr	10.37	1.24	0.12	2.12	....	Cr_2O_3 0.90 Mn O tr	101.78	...	*ab* 8.4 *di* 6.0 *cm* 1.4 *an* 2.5 *hy* 26.7 *tr* 5.8 *ol* 38.3 *nf* 11.7	Cca	C. Klement.....	Bull. Mus. roy. d'hist. Nat. Belgique 1886, 4, 280
89. St. Christophe	39.33	2.15	13.66	25.90	1.51	0.51	0.18	7.79	1.67	0.11	Fe S 6.90	....	Cr_2O_3 0.38	100.09	...	*or* 1.1 *di* 3.8 *cm* 0.9 *ab* 4.2 *hy* 27.9 *tr* 6.9 *an* 3.1 *ol* 42.8 *nf* 9.6	Cg	M. A. Lacroix...	Bull. Soc. de'l Onest de la France, 1906, 2, 6, 81–112
90. Tadjera	39.20	1.64	14.18	25.68	2.66	....	....	8.32		....	Fe S 8.04	....	Cr_2O_3 0.12	99.84	3.60	*an* 4.5 *di* 6.9 *cm* 0.2 *hy* 33.4 *tr* 8.0 *ol* 38.4 *nf* 8.3	Ct	S. Meunier......	Comptes Rendus 1868, 66, 513–519
91. Shelburne	39.19	2.15	15.16	26.24	1.75	0.73	0.22	10.70	0.78	0.04	1.61	0.06	Cr_2O_3 0.62 Mn O 0.12	99.37	3.50	*or* 1.1 *di* 4.9 *cm* 0.9 *ab* 5.8 *hy* 25.5 *tr* 4.4 *an* 2.5 *ol* 41.6 *sc* 0.4 *nf* 11.5	Cg	L. H. Borgström.	Trans. Roy. Astr. Soc. of Canada 1904
92. Alfianello	39.14	0.93	17.42	25.01	1.96	0.75	0.10	11.31	1.09	....	2.71	....		100.42	...	*or* 0.6 *ns* 0.5 *tr* 7.4 *ab* 4.2 *di* 3.8 *nf* 12.4 *hy* 37.7 *ol* 31.5	Ci	H. von Foullon..	Sitzber. Wien Akad. 1883, 88, 1, 433
93. Marion	38.96	2.00	14.52	26.05	1.18	0.38	tr	13.51	1.08	....	2.32	....		100.00	...	*ab* 3.1 *di* 1.5 *tr* 6.3 *an* 3.9 *hy* 41.8 *nf* 14.6 *ol* 28.4	Cwa	C. Rammelsberg.	Monatsber. Berlin Akad. 1870, 457–459. Mass anal. calc. by Wadsworth
94. Aussun	38.72	1.85	16.93	22.53	0.80	0.57	0.11	8.63	0.96	....	Fe S 3.74	Fe_3P 2.00	Chromite 1.83 Mn O tr	98.67	3.54	*or* 0.6 *di* 1.4 *cm* 1.8 *ab* 4.7 *hy* 35.2 *tr* 3.7 *an* 2.2 *ol* 37.3 *sc* 2.0 *nf* 9.6	Cc	H. A. Damour...	Comptes Rendus 1859, 49, 31–36
95. Beaver Creek	37.43	2.17	10.49	23.73	1.76	0.80	0.09	15.53	1.51	0.08	Fe S 5.05	....	Magnetite 0.16 H_2O 0.29 Chromite 0.30 TiO_2 0.08 Ni O 0.03 Cu 0.01 Mn O 0.24 P_2O_5 0.25	100.00	...	*or* 0.6 *di* 4.5 *cm* 0.3 *ab* 6.8 *hy* 26.3 *il* 0.2 *an* 2.2 *ol* 36.2 *ap* 0.3 *tr* 5.1 *nf* 17.1	Cck	W. F. Hillebrand	Am. Jour. Sci. 1894, 3, 47, 430. Mass anal. calc. by Farrington
96. Saline	37.08	1.83	18.04	23.34	2.03	0.26	0.08	7.89	0.95	0.04	1.65	0.05	Fe_2O_3 4.45 H_2O 1.23 Cr_2O_3 1.25 Ni O 0.74 Co O 0.07	100.99	3.62	*or* 0.6 *di* 5.3 *mt* 6.5 *ab* 2.1 *hy* 32.0 *cm* 2.0 *an* 3.6 *ol* 33.2 *tr* 4.5 *sc* 0.2 *nf* 8.0	Cck	H. W. Nichols and E. W. Tillotson	Private contribution
97. Hessle	36.83	2.38	10.85	23.21	1.80	0.94	....	20.08	2.15	0.02	1.88	0.15	Cr_2O_3 0.07 Mn O 0.42 Cu O 0.02 Cl 0.04	100.84	3.70	*ab* 7.9 *di* 5.1 *tr* 5.1 *an* 2.5 *hy* 28.8 *sc* 0.8 *ol* 27.3 *nf* 22.3	Cc	G. Lindstrom....	Kongl. Svenske. Vet. Ak. 1870
98. Ogi	36.75	1.89	8.84	23.36	1.94	0.97	0.16	15.35	1.75		Fe S 5.91	....	Chromite 0.61 Cu + Ni O 0.30 Sn 0.15 Mn O 0.51 Mn 0.18 P_2O_5 0.34	99.01	...	*or* 1.1 *di* 6.0 *cm* 0.6 *ab* 8.4 *hy* 22.7 *ap* 0.7 *an* 0.3 *ol* 35.0 *tr* 5.0 *nf* 17.4	Cw	T. Shimidzu.....	Trans. Asiatic Soc. Japan 1882, 10, 199–203
99. Lixna	36.45	2.52	13.16	25.08	tr	0.72	tr	16.95	1.71	....	2.13	0.14	Chromite 0.70 Mn O 0.03 Mn 0.43	100.02	3.73	*ab* 5.8 *hy* 30.0 *cm* 0.7 *C* 1.4 *ol* 26.7 *tr* 5.0 *sc* 0.8 *nf* 19.1	Cga	A. Kuhlberg....	Archiv. Nat. Liv. Ehst. Kurlands 1867, 1, 4, 1–32

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Name	Si (		Brezina's Symbol	Analyst	Reference
00. Salt Lake City...	36.(	m 0.6 p 0.7 r 5.5 f 17.2		S. L. Penfield....	Am. Jour. Sci. 1886, 3, 32, 228
01. Pultusk..........	35.8	n! 5.5 f 17.8	Cga	C. Rammelsberg.	Monatsber. Berlin Akad. 1870, 448–452. Mass anal. calc. by Wadsworth
02. Khetree..........	35.1	m 0.7 r 4.8 c 0.8 f 20.4	Cgb	D. Waldie......	Jour. Asiat. Soc. Bengal 1869, 38, 2, 252–258
03. Allegan..........	34.(	m 0.7 l 0.2 p 0.7 r 5.1 f 23.1	Cco	H. N. Stokes....	Proc. Washington Acad. Sci. 1900, 2, 41
		OSE			
04. Homestead......	36.(	m 0.7 r 5.3 f 12.3	Cgb	Gümber and Schwager.....	Sitzber. München Akad. 1875, 5, 313–330. Mass anal. calc. by Wadsworth
05. Homestead......	36.(	r 5.8 f 12.5	Cgb	J. L. Smith.....	Am. Jour. Sci. 1875, 3, 10, 362. Mass anal. calc. by Farrington
		SE			
06. Lumpkin........	40.7	r 6.1 f 7.0	Cck	J. L. Smith.....	Am. Jour. Sci. 1870, 2, 50, 339. Mass anal. calc. by Farrington
07. Farmington.....	39.9	m 0.9 r 5.0 f 7.7	Cs	L. G. Eakins....	Am. Jour. Sci. 1892, 3, 43, 66. Mass anal. calc. by Farrington
08. Utrecht........	39.3(	m 0.9 r 5.2 f 12.3	Cca	E. H. Baumhauer	Ann. Phys. Chem. 1845, 66, 465–498
09. Aussun.........	38.7(	m 1.1 r 8.3 f 8.5	Cc	E. P. Harris.....	Chem. Const. Meteorites 1859, 44–51. Mass anal. calc. by Farrington
10. Mauerkirchen...	38.14	r 5.5 c 1.0 f 6.3	Cw	A. Schwager.....	Sitzber. München Akad. 1878, 8, 16–24
11. Alfianello......	37.63	m 1.1 c 1.0 r 7.0 f 7.0	Ci	P. Maissen......	Gazetta Chemica 1884, 13, 369
12. Blansko........	37.08	r 0.2 f 17.1	Cga	J. J. Berzelius...	Ann. Phys. Chem. 1834, 33, 8–25. Mass anal. calc. by von Reichenbach 1865, 124, 213

ANALYSES OF STONE METEORITES—*Continued*

PERFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, PULTUSKOSE—*Continued*

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
100. Salt Lake City	36.05	1.96	11.70	23.02	1.87	0.85	0.06	15.67	1.38	0.10	FeS 5.51	....	Chromite 0.62 H_2O 0.94 P_2O_5 0.26	100.00	3.66	*or* 0.6 *di* 4.9 *cm* 0.6 *ab* 7.3 *hy* 22.8 *ap* 0.7 *an* 1.4 *ol* 37.7 *tr* 5.5 *nf* 17.2		S. L. Penfield	Am. Jour. Sci. 1886, 3, 32, 228
101. Pultusk	35.85	1.96	12.12	24.95	1.56	0.95	0.39	15.55	2.21	....	....	....	Fe_2O_3 3.85	99.39	...	*or* 2.2 *ns* 1.1 *tr* 5.5 *ab* 3.1 *di* 6.2 *nf* 17.8 *hy* 21.7 *ol* 40.8	Cga	C. Rammelsberg	Monatsber. Berlin Akad. 1870, 448–452. Mass anal. calc. by Wadsworth
102. Khetree	35.17	1.77	11.16	23.80	2.37	0.87	tr	18.79	1.26	0.21	1.76	0.12	Cr_2O_3 0.40 Cr 0.10	97.78	3.68	*ab* 7.3 *di* 8.4 *cm* 0.7 *an* 1.1 *hy* 20.2 *tr* 4.8 *ol* 33.2 *sc* 0.8 *nf* 20.4	Cgb	D. Waldie	Jour. Asiat. Soc. Bengal 1869, 38, 2, 252–258
103. Allegan	34.95	2.55	8.47	21.99	1.73	0.66	0.23	21.09	1.81	0.15	FeS 5.05	....	Cr_2O_3 0.53, H_2O 0.25 NiO tr, TiO_2 0.08 MnO 0.18, Cu 0.01 Li_2O tr, P_2O_5 0.27	100.00	3.91	*or* 1.1 *di* 2.4 *cm* 0.7 *ab* 5.8 *hy* 27.7 *il* 0.2 *ol* 29.8 *ap* 0.7 *tr* 5.1 *nf* 23.1	Cco	H. N. Stokes	Proc. Washington Acad. Sci. 1900, 2, 41

PERFEMIC, DOSILICIC, PERPOLIC, PYROLIC, PERMIRLIC, PERMIRIC, MAGNESIFERROUS, HOMESTEADOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
104. Homestead	36.98	1.18	22.39	18.21	1.39	0.82	0.57	10.27	2.05	....	FeS 5.25	....	Cr_2O_3 0.49 MnO 0.25	99.85	3.75	*or* 3.3 *ns* 0.9 *cm* 0.7 *ab* 3.1 *di* 5.7 *tr* 5.3 *hy* 24.8 *nf* 12.3 *ol* 42.1	Cgb	Gümber and Schwager	Sitzber. München Akad. 1875, 5, 313–330. Mass anal. calc. by Wadsworth
105. Homestead	36.92	0.64	22.64	20.02	....	1.42	....	11.17	1.30	0.07	FeS 5.82	....	Li_2O tr	100.00	3.57	*ab* 3.1 *ns* 2.1 *tr* 5.8 *hy* 34.9 *nf* 12.5 *ol* 41.5	Cgb	J. L. Smith	Am. Jour. Sci. 1875, 3, 10, 362. Mass anal. calc. by Farrington

PERFEMIC, DOSILICIC, PERPOLIC, DOPOLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, FARMINGTONOSE

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
106. Lumpkin	40.73	2.28	14.70	28.10	0.04	1.05	....	6.11	0.84	0.05	FeS 6.10	....		100.00	3.65	*ab* 8.9 *hy* 26.2 *tr* 6.1 *an* 0.3 *ol* 51.1 *nf* 7.0 *C* 0.5	Cck	J. L. Smith	Am. Jour. Sci. 1870, 2, 50, 339. Mass anal. calc. by Farrington
107. Farmington	39.95	1.79	15.77	26.16	1.75	0.73	0.11	6.68	0.94	0.06	FeS 5.00	....	Cr_2O_3 0.58 NiO 0.32 CrO tr MnO 0.16	100.00	...	*or* 0.6 *di* 5.6 *cm* 0.9 *ab* 5.8 *hy* 23.1 *tr* 5.0 *an* 1.7 *ol* 49.7 *nf* 7.7	Cs	L. G. Eakins	Am. Jour. Sci. 1892, 3, 43, 66. Mass anal. calc. by Farrington
108. Utrecht	39.30	2.25	15.30	24.37	1.48	1.39	0.15	11.07	1.24		1.90	0.01	Cr_2O_3 0.66 MnO + NiO 0.61 CuO + SnO_2 0.25 Cu + Sn 0.02	100.00	3.61	*or* 1.1 *ns* 0.2 *cm* 0.9 *ab* 11.0 *di* 6.0 *tr* 5.2 *hy* 19.1 *nf* 12.3 *ol* 42.8	Cca	E. H. Baumhauer	Ann. Phys. Chem. 1845, 66, 465–498
109. Aussun	38.79	2.27	18.15	25.29	....	1.14	0.18	7.11	1.02	0.06	2.11	....	Cr_2O_3 0.77 MnO 0.30 Cu + Sn 0.24 Mn 0.04 FeS 2.53	100.00	3.50	*or* 1.1 *hy* 25.2 *cm* 1.1 *ab* 9.4 *ol* 45.0 *tr* 8.3 *C* 0.3 *nf* 8.5	Cc	E. P. Harris	Chem. Const. Meteorites 1850, 44–51. Mass anal. calc. by Farrington
110. Mauerkirchen	38.14	2.51	25.70	21.73	2.27	1.00	0.48	6.30		....	2.09	0.14	Cr_2O_3 0.39	100.75	3.46	*or* 2.8 *di* 8.2 *tr* 5.5 *ab* 8.4 *hy* 8.5 *sc* 1.0 *an* 1.1 *ol* 57.1 *nf* 6.3 *cm* 0.7	Cw	A. Schwager	Sitzber. München Akad. 1878, 8, 16–24
111. Alfianello	37.63	1.78	24.42	23.43	0.89	1.09	0.24	5.76	1.14	0.08	2.54	0.15	Cr_2O_3 0.10 MnO 0.13 CrO_3 0.62	100.00	...	*or* 1.1 *ns* 0.2 *cm* 1.1 *ab* 8.3 *di* 3.6 *sc* 1.0 *hy* 17.3 *tr* 7.0 *ol* 51.9 *nf* 7.0	Ci	P. Maissen	Gazetta Chemica 1884, 13, 369
112. Blansko	37.08	2.39	14.95	23.90	1.25	0.74	0.19	16.09	0.87	0.06	0.06	....	Chromite 0.62 NiO 0.21 MnO 0.40 Cu + Sn 0.08	98.98	3.40	*or* 1.1 *di* 2.7 *tr* 0.2 *ab* 6.3 *hy* 18.4 *nf* 17.1 *an* 2.8 *ol* 50.5	Cga	J. J. Berzelius	Ann. Phys. Chem. 1834, 33, 8–25. Mass anal. calc. by von Reichenbach 1865, 124, 213

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Name		Brezina's Symbol	Analyst	Reference
13. Hessle..........	*tr* 0.5 *nf* 18.5	Cc	A. E. Nordenskjöld.........	Ann. Phys. Chem 1870, 141, 205–224
14. Buschhof........	*cm* 0.2 *tr* 6.0 *nf* 9.4	Cwa	Grewingk and Schmidt......	Archiv. Nat. Liv. u. Ehst. Kurlands 1864, 3, 421–554
15. Forest City......	*cm* 0.2 *tr* 6.2 *nf* 19.4	Ccb	L. G. Eakins....	Am. Jour. Sci. 1890, 3, 40, 320. Mass anal. calc. by Farrington
16. Cape Girardeau..	*cm* 0.7 *ap* 0.7 *tr* 5.7 *nf* 17.0	Cc	S. L. Penfield....	Am. Jour. Sci. 1886, 3, 32, 230. Mass anal. calc. by Farrington
17. Heredia.........	*nf* 26.1	Ccb	I. Domeyko.....	Ann. de la Universitad de Chile 1859, 16, 335–339. Mass anal. calc. by Wadsworth
18. Cabezzo de Mayo	*cm* 0.9 *tr* 20.6 *nf* 15.0	Cw	S. Meunier......	Thèse Faculté des Sciences de Paris, 1869, 9. Mass anal. calc. by Farrington
	E			
19. Shytal..........	*tr* 2.1 *sc* 0.4 *nf* 12.1	Cib	T. Hein.........	Sitzber. Wien Akad. 1866, 54, 2, 558–561
20. Ornans..........	*cm* 0.4 *tr* 7.4 *nf* 6.0	Cco	F. Pisani........	Comptes Rendus, 1868, 67, 663–665
21. Cold Bokkeveld..	*cm* 1.1 *tr* 9.2 *nf* 2.5	K	E. P. Harris.....	Sitzber. Wien Akad. 1859, 35, 512
22. Mount Vernon...	*mt* 0.2 *cm* 1.0 *tr* 0.7 *sc* 2.0 *nf* 32.8	P	Wirt Tassin.....	Proc. U. S. Nat. Mus. 1905, 28, 213–217. Mass anal. calc. by Farrington
	IOSE			
23. Steinbach.......	*cm* 0.3 *sc* 0.8 *tr* 7.22 *nf* 50.8	S	Winkler.........	Nova Acta. der K. Leop. Carol. deutsch Akad. 1878, 40. Mass anal. calc. by Farrington
	E			
24. Mincy..........	*tr* 1.0 *sc* 0.6 *nf* 55.1	M	J. E. Whitfield...	Am. Jour. Sci. 1887, 3, 34, 468–469. Mass anal. calc. by Farrington
	OSE			
25. Marjalahti.......		P	L. H. Borgström	Die Met. von Hvittis u. Marjalahti, Helsingfors 1903, 57. Mass anal. calc. by Farrington

PERFEMIC, DOSILICIC, PERPOLIC, DOMOLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, FARMINGTONOSE—*Continued*

Name	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	Fe	Ni	Co	S	P	Miscellaneous	Sum	Sp. gr.	Norm	Brezina's Symbol	Analyst	Reference
113. Hessle	36.91	1.55	13.43	25.06	2.08	1.57	....	16.36	2.16	tr	0.18	tr	Cu + Sn 0.02 C 0.68	100.00	3.92	*ab* 7.9 *ns* 1.2 *tr* 0.5 *di* 8.5 *nf* 18.5 *hy* 11.8 *ol* 50.9	Cc	A. E. Nordenskjöld	Ann. Phys. Chem 1870, 141, 205–224
114. Buschhof	36.01	2.48	20.98	27.17	0.71	0.26	0.33	7.92	1.51	tr	2.18	0.01	C + SnO_2 + loss 0.15	100.00	3.52	*or* 1.7 *hy* 17.5 *cm* 0.2 *ab* 2.1 *ol* 57.7 *tr* 6.0 *an* 3.6 *nf* 9.4	Cwa	Grewingk and Schmidt	Archiv. Nat. Liv. u. Ehst. Kurlands 1864, 3, 421–554
115. Forest City	35.62	2.08	10.27	23.93	1.40	0.81	0.06	18.08	1.19	0.13	Fe S 6.19	tr	Cr_2O_3 0.10 P_2O_5 tr NiO 0.14 MnO tr	100.00	3.64	*or* 0.6 *di* 4.0 *cm* 0.2 *ab* 6.8 *hy* 20.8 *tr* 6.2 *an* 2.0 *ol* 40.2 *nf* 19.4	Ccb	L. G. Eakins	Am. Jour. Sci. 1890, 3, 40, 320. Mass anal. calc. by Farrington
116. Cape Girardeau	35.57	2.27	11.04	23.75	1.38	0.86	0.11	16.46	1.32	0.11	Fe S 5.68	....	Chromite 0.68 H_2O 0.47 P_2O_5 0.29 Cu 0.01	100.00	3.67	*or* 0.6 *di* 2.7 *cm* 0.7 *ab* 7.3 *hy* 21.4 *ap* 0.7 *an* 2.0 *ol* 41.4 *tr* 5.7 *nf* 17.9	Cc	S. L. Penfield	Am. Jour. Sci. 1886, 3, 32, 230. Mass anal. calc. by Farrington
117. Heredia	33.10	1.25	16.97	20.39	1.19	0.83	0.04	24.59	1.51	....	....	....		99.87	...	*ab* 6.8 *di* 4.8 *nf* 26.1 *hy* 15.3 *ol* 46.9	Ccb	I. Domeyko	Ann. de la Universitad de Chile 1859, 16, 335–339. Mass anal. calc. by Wadsworth
118. Cabezzo de Mayo	29.29	0.51	5.24	28.00	0.09	0.35	tr	13.66	1.37	....	Fe S 20.57	....	Chromite 0.92	100.00	...	*ab* 2.6 *di* 0.4 *cm* 0.9 *hy* 8.0 *tr* 20.6 *ol* 50.4 *nf* 15.0	Cw	S. Meunier	Thèse Faculté des Sciences de Paris, 1869, 9. Mass anal. calc. by Farrington
PERFEMIC, DOSILICIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, ORNANSOSE																			
119. Shytal	32.05	2.54	23.88	22.90	1.12	1.50	0.67	10.38	1.63	....	0.78	0.05	NiO 0.86 Cu 0.11	98.47	3.55	*lc* 3.1 *ns* 0.7 *tr* 2.1 *ne* 5.1 *di* 1.8 *sc* 0.4 *ol* 71.4 *nf* 12.1 *am* 1.2	Cib	T. Hein	Sitzber. Wien Akad. 1866, 54, 2, 558–561
120. Ornans	31.23	4.32	24.71	24.40	2.27	0.55		4.12	1.85	....	2.69	....	Chromite 0.40 NiO 2.88 MnO tr	99.42	3.60	*ab* 2.6 *ol* 69.4 *cm* 0.4 *an* 9.2 *am* 0.8 *tr* 7.4 *mo* 2.3 *nf* 6.0	Cco	F. Pisani	Comptes Rendus, 1868, 67, 663–665
121. Cold Bokkeveld	30.80	2.05	29.94	22.20	1.70	1.23		2.50	....	tr	3.38	....	Cr_2O_3 0.76 CuO 0.03 NiO 1.30 C 1.67 MnO 0.97 Bit. 0.25	98.78	2.69	*ne* 5.7 *di* 1.1 *cm* 1.1 *an* 0.3 *ol* 72.5 *tr* 9.2 *am* 1.1 *nf* 2.5	K	E. P. Harris	Sitzber. Wien Akad. 1859, 35, 512
122. Mount Vernon	22.95	0.27	13.20	26.68	....	....	....	27.66	4.71	0.32	Fe S 0.69	Fe_3P 1.95	Fe_2O_3 0.11 Cu 0.03 Chromite 1.00 Graphite 0.09 NiO 0.13 Al 0.12 MnO 0.09	100.00	...	*C* 0.3 *ol* 58.9 *mt* 0.2 *mo* 4.1 *cm* 1.0 *tr* 0.7 *sc* 2.0 *nf* 32.8	P.	Wirt Tassin	Proc. U. S. Nat. Mus. 1905, 28, 213–217. Mass anal. calc. by Farrington
PERFEMIC, DOMETALLIC, PERPOLIC, PERPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, STEINBACHOSE																			
123. Steinbach	27.47	0.68	3.49	8.48	0.70	0.48	....	45.71	4.95	0.12	Fe S 7.22	0.07	Chromite 0.32 MnO 0.16 Schreibersite 0.15	100.00	...	*Q* 8.7 *ns* 1.2 *cm* 0.3 *ab* 3.7 *di* 2.9 *sc* 0.8 *hy* 25.8 *tr* 7.22 *nf* 50.8	S	Winkler	Nova Acta. der K. Leop. Carol. deutsch Akad. 1878, 40. Mass anal. calc. by Farrington
PERFEMIC, DOMETALLIC, PERPOLIC, DOPYRIC, PERMIRLIC, PERMIRIC, DOMAGNESIC, MINCIOSE																			
124. Mincy	20.64	3.55	8.88	8.08	2.71	....	....	49.18	5.73	0.16	Fe S 0.99	0.08		100.00	4.84	*an* 9.7 *di* 3.0 *tr* 1.0 *hy* 21.5 *sc* 0.6 *ol* 9.0 *nf* 55.1	M	J. E. Whitfield	Am. Jour. Sci. 1887, 3, 34, 468–469. Mass anal. calc. by Farrington
PERFEMIC, DOMETALLIC, PERPOLIC, PEROLIC, PERMIRLIC, PERMIRIC, PERMAGNESIC, MARJALAHTOSE																			
125. Marjalahti	8.07	....	2.38	9.47	....	0.04	0.01	73.95	5.71	0.34	....	....	Cr_2O_3 0.03	100.00	...	*ol* 20.0 *nf* 80.0	P	L. H. Borgström	Die Met. von Hvittis u. Marjalahti, Helsingfors 1903, 57. Mass anal. calc. by Farrington

The following 3, 59-110) or were overlooked in making that

Name		Reference
Bohumilitz		1891, A. N. H. Wien, 6, 144
Cosby	h	1861, Pogg. Ann. 94, 250
Nuleri		1907, Bull. Geol. Survey, W. Australia, 26, 24–26
Wichita		1884, A. J. S. 3, 28, 287
Wichita	schenk	1891, A. N. H. Wien, 6, 153
Wichita		1892, A. N. H. Wien, 7, 155

Ivanpah		1891, A. N. H. Wien, 6, 145
Ivanpah		1892, A. N. H. Wien, 6, 149
Inca		1907, Neues Jahrb. Festband. 230
Ilimäe		1871, Sitzb. Wien Akad. 194
Joe Wright	schenk	1891, A. N. H. Wien, 6, 158
Rancho de la Pila		1884, Beitr. Abh. natur. Ver. Bremen, 8, 517
Tanokami		1906, Beitr. z. Min. Japan, 2, 30–52
Williamstown		1908, A. J. S. 4, 25, 49–50

Muonionalusta		1909, Bull. Geol. Inst. Univ. Upsala, 9, 236

Ainsworth		1908, A. J. S. 4, 25, 107

Guffey	nd Blair	1909, Am. Mus. Jour. 9, 243
Weaver		1910, Mineralogy of Arizona, 22
Weaver		Same

ADDITIONAL ANALYSES OF IRON METEORITES

The following analyses of iron meteorites have been made since the writer's compilation (Pubs. Field Museum Geol. Ser. 1907, 3, 59-110) or were overlooked in making that compilation.

COARSE OCTAHEDRITES

Name	Fe	Ni	Co	Cu	Cr	P	S	C	Si	Cl	Insol	Miscellaneous	Total	Sp. gr.	Analyst	Reference
Bohumilitz	90.77	7.72	1.22	....	....	....	....	....	....	....	....		99.71	...	O. Koestler	1891, A. N. H. Wien, 6, 144
Cosby $\frac{2}{2}$	89.72	10.12	0.42	....	....	0.11	tr	....	....	....	....		100.37	...	R. v. Reichenbach	1861, Pogg. Ann. 94, 250
Nuleri	93.57	5.79	0.41	tr	....	0.13	tr	0.01	....	tr	....		100.00	7.79	E. S. Simpson	1907, Bull. Geol. Survey, W. Australia, 26, 24-26
Wichita	90.77	8.34	0.26	0.02	....	0.14	0.02	....	....	....	...	Sn 0.04 FeO + SiO_2 1.32 Graphite 0.19	99.88	...	J. W. Mallett	1884, A. J. S. 3, 28, 287
Wichita	91.39	7.91	0.40	tr	....	....	....	....	....	....	...		99.70	...	Cohen and Weinschenk	1891, A. N. H. Wien, 6, 153
Wichita	92.37	6.74	0.59	0.03	....	0.03	....	....	....	....	...		99.76	...	Manteuffel	1892, A. N. H. Wien, 7, 155

MEDIUM OCTAHEDRITES

Name	Fe	Ni	Co	Cu	Cr	P	S	C	Si	Cl	Insol	Miscellaneous	Total	Sp. gr.	Analyst	Reference
Ivanpah	91.12	6.92	1.73	....	....	....	....	....	....	....	....		99.77	...	O. Koestler	1891, A. N. H. Wien, 6, 145
Ivanpah	92.68	7.43	0.66	0.01	....	0.03	....	....	....	....	....		100.81	...	Manteuffel	1892, A. N. H. Wien, 6, 149
Inca	90.73	8.20	0.22	....	0.35	0.23	tr	0.24	....	....	....		99.97	7.64	Halbach	1907, Neues Jahrb. Festband. 230
Ilimäe	91.53	7.14	0.41	tr	....	0.44	....	....	....	....	....		99.52	...	C. Ludwig	1871, Sitzb. Wien Akad. 194
Joe Wright	91.67	7.53	0.99	....	....	tr	....	....	....	....	....		100.19	...	Cohen and Weinschenk	1891, A. N. H. Wien, 6, 158
Rancho de la Pila	91.78	8.35	0.01	....	....	tr	....	tr	....	....	....		100.14	...	Janke	1884, Beitr. Abh. natur. Ver. Bremen, 8, 517
Tanokami	90.11	8.56	0.62	....	....	0.43	....	....	....	....	....		99.95	7.60	Kodera	1906, Beitr. z. Min. Japan, 2, 30-52
Williamstown	91.54	7.26	0.52	0.03	0.05	0.12	0.17	tr	tr	....	....		99.69	8.10	W. Tassin	1908, A. J. S. 4, 25, 49-50

FINE OCTAHEDRITES

Name	Fe	Ni	Co	Cu	Cr	P	S	C	Si	Cl	Insol	Miscellaneous	Total	Sp. gr.	Analyst	Reference
Muonionalusta	91.10	8.02	0.69	0.01	0.01	0.05	....	....	....	....	....		99.88	7.89	R. Mauzelius	1909, Bull. Geol. Inst. Univ. Upsala, 9, 236

BRECCIATED OCTAHEDRITES

Name	Fe	Ni	Co	Cu	Cr	P	S	C	Si	Cl	Insol	Miscellaneous	Total	Sp. gr.	Analyst	Reference
Ainsworth	92.22	6.49	0.42	0.01	0.01	0.28	0.07	0.09	0.05	....	....		99.64	7.85	W. Tassin	1908, A. J. S. 4, 25, 107

ATAXITES

Name	Fe	Ni	Co	Cu	Cr	P	S	C	Si	Cl	Insol	Miscellaneous	Total	Sp. gr.	Analyst	Reference
Guffey	88.69	10.55	....	....	0.02	0.02	0.02	0.02	....	....	....		99.87	7.94	Booth, Garrett and Blair	1909, Am. Mus. Jour. 9, 243
Weaver	81.81	16.63	1.18	....	....	tr	tr	....	....	....	....	Mn tr	99.62	7.99	F. Hawley	1910, Mineralogy of Arizona, 22
Weaver	79.60	18.80	1.60	....	....	tr	tr	....	....	....	....	Mn tr	100.00	7.98	W. B. Alexander	Same

CATALOGUE OF THE COLLECTION OF METEORITES

Since the publication of the last catalogue of the meteorite collection* the collection has been more than doubled both in number of falls and in weight. The last catalogue listed 251 falls and a weight of 2,289 kilograms; the present catalogue records 657 falls and a weight of 7,566 kilograms. This great increase has come chiefly through the acquisition of the Ward-Coonley collection, a collection which numbered 620 falls and had a weight of 2,495 kilograms. The Ward-Coonley collection included that of James R. Gregory of London, numbering 406 falls, and that of Count Julien de Siemaschko of St. Petersburg, numbering 402 falls. The specimens listed as belonging to these collectors in Wülfing's catalogue† are now therefore chiefly to be found in the Field Museum. Among important specimens included in the Gregory collection were an individual of Youndegin weighing 141 kilos (310 lbs.) and of Nejed weighing 48 kilos (105 lbs.); also about one-third the original mass of Pipe Creek. The Siemaschko collection was notable especially for its fine series of Russian and Siberian meteorites, among which were a large individual of Indarch weighing 18 kilos, a large mass weighing 2.2 kilos of Mighei, about one-third the original mass of Pavlodar (Jamyschewa) and a large mass of Tabory (Ochansk). The specimens obtained by Professor Ward personally included masses of Ilimaës, Lampa, Arispe, Yanhuitlan, Santa Rosa, Ballinoo, Barratta and Roebourne. Individuals or large masses of the Bath Furnace, Billings, Bluff, Canyon City, Castine, Estacado, Illinois Gulch, Luis Lopez, McKinney, Ness County, Oakley, Petersburg, Saint Genevieve and Surprise Springs meteorites also proved important features of Professor Ward's collection, and the amount of Canyon Diablo contained in his collection was the largest in the possession of any collector. In addition to the material obtained from the Ward-Coonley collection the Museum has acquired subsequent to the publication of the last catalogue, representatives of about 50 falls. These included the total masses of Ahumada (52 kilos), Blanket (3 kilos), Leighton (850 grams), Pickens County (380 grams), Rodeo (44 kilos), South Bend (2 kilos) and the large masses of Quinn Canyon and Davis Mountains weighing 1,450 and 690 kilos respectively.

*Pubs. Field Col. Mus. 1903, Geol. Ser. 2, 79–124.

†Die Meteoriten in Sammlungen. Tübingen, 1897.

The following table shows the falls having a larger representation in this collection than in any other so far as known; also for comparison the total known weights of the falls:

Name	Weight in grams in Museum collection	Total known weight in grams
Ahumada	46,999	52,548
Ballinoo	11,111	42,909
Barratta	94,241	167,516
Bath Furance	84,174	86,293
Billings	13,270	24,462
Bishop Canyon	8,649	8,649
Blanket	3,148	3,148
Bluff	35,577	146,000
Brenham	492,888	900,000
Canyon City	4,635	8,493
Canyon Diablo	2,306,613	4,000,000
Castine	42	93
Colfax	891	2,200
Crab Orchard	14,585	43,000
Davis Mountains	690,000	692,265
Estacado	118,602	290,000
Farmington	29,826	84,000
Hopewell Mounds	145	150
Illinois Gulch	662	2,435
Indarch	20,087	27,000
Indian Valley	9,775	14,200
Kenton County	74,445	163,000
Leighton	460	850
Long Island	543,275	564,000
Los Reyes	19,500	19,500
Luis Lopez	3,061	6,903
McKinney	57,336	137,200
Mighei	2,255	7,948
Morristown	4,598	16,300
Ness County	19,790	25,000
Oakley	9,105	27,900
Pavlodar	1,360	4,036
Petersburg	214	1,764
Pickens County	380	380
Pipe Creek	4,307	13,500
Quinn Canyon	1,450,000	1,450,000
Rodeo	30,240	44,100
Roebourne	39,812	86,523
Saint Genevieve	106,919	244,167
Saline	22,902	31,130
Santa Rosa	99,280	612,500
Scott City	1,860	2,035
South Bend	2,463	2,494
Surprise Springs	1,008	1,524
Toluca	227,772	1,000,000
Ute Pass	120	120
Veramin	844	45,000

The following falls are represented in the collection by large numbers of complete individuals:

Brenham	4 large individuals
Canyon Diablo	17 large, 105 small individuals
Estherville	143 individuals
Forest City	722 individuals

Holbrook	197 individuals
Mocs	38 individuals
Ness County	27 individuals
Pultusk	173 individuals
Toluca	34 individuals

Also of the following falls one or more complete, or nearly complete, individuals are included in the collection: Admire, Agen, Ahumada, Arispe, Barratta (2), Bath Furnace, Bielokrynitschie, Bischtübe, Bishop Canyon, Blanket (2), Blansko, Bluff, Cangas de Onis, Crab Orchard, Davis Mountains, Dokachi, Doña Inez (5), Gilgoin, Glorieta Mountain (2), Hessle (3), Homestead (2), Indarch, Kyushu, Leighton, Limerick, Llano del Inca (2), Los Reyes, Modoc (3), Nagy-Borove, Nejed, Pickens County, Plainview, Quinn Canyon, Scott City (2), South Bend, Stannern and Vaca Muerta.

The form and arrangement of this catalogue are similar to those of previous catalogues of the collection, the arrangement being an alphabetical one for all falls, with a description, weight and number for each specimen. The classification given to each fall has been in the main that assigned by Brezina in the Ward-Coonley catalogue.* Where obvious discrepancies occur, however, they have been noted by the writer. In some cases where there was a lack of correspondence between the specimen and Brezina's classification, sufficient material did not seem to be at hand to warrant suggesting a change, while in other cases it appeared that Brezina's determination might have been based on insufficient material. A determination of the classification of each meteorite in whatever collection possessed the largest quantity of the fall would, in many cases, be desirable, although even with a large amount of material individual judgments might differ. The writer has followed Cohen† in grouping together the various falls of Great Nama Land (Amalia, Great Fish River, Lion River, Mukerop and Springbok River) under the single name of Bethany. This reduces the number of falls from that region considerably from those usually listed, but the great similarity of the etching figures of these meteorites make it seem probable to the writer, as it has to other authorities, that these masses had a single origin. Berwerth‡ has been followed in grouping the Japanese falls, Oshima, Hishikari, Maeme and Shigetomi, under the single name of Kyushu. In the case of Coahuila the various irons have been grouped according to the practice which has now become common. Effort has been made to exclude all doubtful falls and if in the practice of this principle some specimens which may later

*Catalogue of the Ward-Coonley Collection, Chicago, 1904, pp. 97-103.

†Meteoritenkunde, Heft 3, p. 324.

‡Fortschritte der Min. Krist. u. Pet. 1912, Bd. 2, 234.

prove genuinely meteoric have been excluded, the injury to the subject is, in the opinion of the writer, less than if the opposite policy were pursued.

Macquarie River and Queensland which were listed in Prof. Ward's catalogue have been discontinued, Macquarie River because it has been found by analysis to be non-meteoric and Queensland because of lack of satisfactory data concerning it. The illustrations accompanying the catalogue show some individual meteorites of the collection which have not been previously figured.

CATALOGUE OF THE COLLECTION.

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Abert Iron. Locality unknown.	
1	Found 1887	Iron. Medium octahedrite. Etched slab with crust on edge. Cat. No. 1083.	49
		Adargas, (Concepcion), Chihuahua, Mexico.	
2	Found 1780	Iron. Medium octahedrite. Full-sized etched section, 11x10 cm. Cat. No. 1013.	266
		Polished slab with crust. Figures appear on the polished surface. Cat. No. 1012.	80
		Admire, Lyons Co., Kansas.	
3	Found 1881	Iron-stone. Brecciated pallasite. Complete individual. Form spheroidal. Much oxidized. Cat. No. 761.	7,700
		End piece with polished surface 23x31 cm. Cat. No. 834.	7,370
		Thick, full-sized section. Polished. Cat. No. 1270.	2,722
		Polished section. Cat. No. 557.	594
		Agen, Lot-et-Garonne, France.	
4	Fell 1814 Sept. 5 Noon	Stone. Veined intermediate chondrite. Nearly complete individual with sawed surface. Cat. No. 1381.	292
		Mass with crust. Interior light-gray with darker spots. Cat. No. 526.	85
		Agra, (Kadonah), Doab, India.	
5	Fell 1822 Aug. 7 Night	Stone. Veined gray chondrite.	
		Fragment with crust. Cat. No. 1508.	18
		Fragment with crust. Cat. No. 584.	1
		Ahnigito, see Cape York.	
		Ahumada, Chihuahua, Mexico.	
6	Found 1909	Iron-stone. Pallasite. Nearly complete individual with sawed surface. Cat. No. 780.	44,847
		Full-sized slab showing structure of metal sponge with angular pores filled with chrysolite. Cat. No. 780.	2,152
		Ainsworth, Brown Co., Nebraska.	
7	Found 1907	Iron. Brecciated octahedrite. Full-sized slab. Cat. No. 767.	544
		Full-sized etched slab showing irregular inclusions of schreibersite. Cat. No. 977.	164
		Akburpur. N. W. Provinces, India.	
8	Fell 1838 April 18	Stone. Brecciated gray chondrite. Fragment with crust and polished surface. Metal abundant. Cat. No. 1507.	7

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
9	Fell 1806 Mar. 15 5 P. M.	**Alais,** Gard, France. Stone. Carbonaceous chondrite. Coarse, brown-black powder resembling an earthy coal. Very friable. Cat. No. 1486.	14
10	Fell 1766 July 5 P. M.	**Albareto,** Modena, Italy. Stone. Spherulitic chondrite. Sawed fragment with crust. Cat. No. 1755.	6
11	Fell 1835 Aug. 4 4:30 P. M.	**Aldsworth,** Gloucestershire, England. Stone. Veined gray chondrite. Fragment with crust. Cat. No. 1776.	4
12	Fell 1873 (?)	**Aleppo,** Syria. Stone. Brecciated white chondrite. Fragment with crust. Cat. No. 1778.	10
		Fragment from interior. Cat. No. 1779.	9
		Fragment with crust. Cat. No. 544.	1
13	Fell 1860 Feb. 2 11:45 A. M.	**Alessandria,** Alessandria, Italy. Stone. Veined gray chondrite. Mass with crust and polished surface. Metal abundant. Cat. No. 1513.	70
14	Fell 1883 Feb. 16 3 P. M.	**Alfianello,** Brescia, Italy. Stone. Intermediate chondrite. Mass with crust. Cat. No. 1387.	4,082
		Mass from interior. Cat. No. 1386.	970
		Mass with crust. Cat. No. 1385.	475
		Mass with crust. Cat. No. 334.	300
		Mass with crust, pitted. Cat. No. 1384.	238
		Mass with crust. Cat. No. 1383.	147
		Mass from interior. Cat. No. 333.	134
		Mass with crust. Cat. No. 332.	24
15	Found 1887	**Algoma,** Kewanee Co., Wisconsin. Iron. Medium octahedrite. Etched fragment with crust. Cat. No. 1059.	10
16	Fell 1899 July 10 8 A. M.	**Allegan,** Allegan Co., Michigan. Stone. Spherical chondrite. Mass with crust. Chondri readily separable. Cat. No. 1433.	295
		Mass with crust, Cat. No. 1432.	270
		Mass with crust. Cat. No. 1430.	124
		Mass from interior. Cat. No. 1431.	139
		Mass with crust. Cat. No. 498.	86
		Mass with crust. Gift of Prof. H. A. Ward. Cat. No. 500.	56
17	Found 1898	**Alt Biela,** Moravia, Austria. Iron. Fine octahedrite. Etched section with crust. Figures well marked. Cat. No. 1070.	19
18	Found 1889	**Amates,** Guerrero or Morelos, Mexico. Iron. Fine octahedrite. Oxidized octahedral fragments. Cat. No. 1173.	3

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Ambapur Nagla, N. W. Provinces, India.	
19	Fell 1895 Mar. 27	Stone. Crystalline spherulitic chondrite. Fragment from interior. Cat. No. 1575.	13
		Fragment from interior. Cat. No. 1577.	13
		Fragment with crust. Cat. No. 1576.	5
		Anderson, Hamilton Co., Ohio.	
20	Prehistoric	Ironstone. Pallasite. Fragments. Cat. No. 1317.	2
		Andover, Oxford Co., Maine.	
21	Fell 1898 Aug. 5 7:30 A. M.	Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1466.	91
		Angers, Maine-et-Loire, France.	
22	Fell 1822 June 3 8:30 P. M.	Stone. Veined white chondrite. Fragment from interior. Cat. No. 1468.	25
		Fragment with crust. Cat. No. 1469.	3
		Angra dos Reis, Rio Janeiro, Brazil.	
23	Fell 1869 Jan. 30 5 A. M.	Stone. Angrite. Sawed slice. Cat. No. 1369.	6
		Fragment with crust. The black, smooth crust characteristic of this meteorite is well shown. Cat. No. 1368.	4
		Apoala, Oaxaca, Mexico.	
24	Found 1889	Iron. Fine octahedrite. Full-sized, etched section. Shows circular nodules of troilite and elongated ones of schreibersite. Cat. No. 1009.	1,360
		Full-sized, etched section. Shows Reichenbach lamellae. Cat. No. 1008.	764
		Apolonia, see Santa Apolonia.	
		Apt, (Saurette), Vauchese, France.	
25	Fell 1803 Oct. 8 10 A. M.	Stone. Veined gray chondrite. Mass with crust. Extensive veining gives a brecciated appearance. Cat. No. 1472.	34
		Aragon, Polk Co., Georgia.	
26	Found 1898	Iron. Nickel-poor ataxite. Two fragments. Cat. No. 1962.	5
		Arispe. Sonora, Mexico.	
27	Found 1898	Iron. Coarsest octahedrite. End piece of 40 kg. individual. Etched face 30x44 cm. Cat. No. 1089.	32,659
		Nearly complete individual. Loaned by W. P. Blake. Cat. No. 781.	8,184
		Thick, etched slab. Cat. No. 1011.	1,304
		Full-sized, etched section. Gift of W. P. Blake. Cat. No. 781.	350
		Arlington, Sibley Co., Minnesota.	
28	Found 1894	Iron. Medium octahedrite. Etched slab with crust on broad surface. Cat. No. 976.	94
		Etched fragment, with crust. Shows typical octahedral figures, with the kamacite uniformly bordered with taenite. Cat. No. 459.	70

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Asco, Corsica.	
29	Fell 1805 Nov.	Stone. Veined white chondrite. Fragment with crust and large mass of troilite. Cat. No. 1522.	4
		Fragment from interior. Cat. No. 1523.	5
		Asheville, (Baird's Farm), Buncombe Co., North Carolina.	
30	Found 1839	Iron. Medium octahedrite. Etched fragment crust. Cat. No. 1086.	5
		Assam, India.	
31	Found 1846	Stone. Brecciated gray chondrite. Coarse, dark powder with one light-colored fragment. Cat. No. 1829.	3
		Assisi, Perugia, Italy.	
32	Fell 1886 May 24 7 A. M.	Stone. Spherulitic chondrite. Sawed fragment with crust. Interior dark gray. Cat. No. 1502.	70
		Fragment with crust. Cat. No. 1503.	60
		Atemajac, Sierra de Topalpo, Jalisco, Mexico.	
33	Fell 1896 Feb. 26	Stone. Gray chondrite. Mass with crust. Cat. No. 1521.	32
		Aubres, Drome, France.	
34	Fell 1836 Sept. 14 3 P. M.	Stone. Bustite. Fragments. Color ash gray. Cat. No. 1506.	3
		Auburn, Lee Co., Alabama.	
35	Found 1867	Iron. Hexahedrite. Two irregular fragments with oxidized surfaces. Surfaces are rounded like individual meteorites. Cat. No. 1111.	23
		Sawed fragments with crust. Cat. No. 92.	5
		Augustinowka, Ekaterinoslaw, Russia.	
36	Found 1890	Iron. Fine octahedrite. Etched end piece. Contains large troilite nodule and veins of "iron glass." Cat. No. 971.	960
		Sawed mass with crust. Etched. Cat. No. 508.	217
		Numerous oxidized fragments. Cat. No. 972.	72
		Oxidized fragment colored green by nickel salts. Cat. No. 507.	59
		Aumieres, Lozere, France.	
37	Fell 1842 June 3 9 P. M.	Stone. Veined white chondrite. Fragment with crust. Cat. No. 1741.	19
		Fragment from interior with one polished surface. Metallic grains few. Cat. No. 1742.	15
		Fragment with crust. Cat. No. 491.	8
		Aussun, (Clarac), Haute Garonne, France.	
38	Fell 1858 Dec. 9 7:30 A. M.	Stone. Spherical chondrite. Mass from interior. Cat. No. 1510.	182
		Mass with crust and sawed surface. Cat. No. 1511.	160
		Mass from interior. Cat. No. 272.	22
		Mass from interior. Cat. No. 271.	13

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
39	Fell 1856 June	**Avilez,** Durango, Mexico. Stone. Spherical chondrite. Fragment with crust. Cat. No. 1574.	6
40	Found 1842	**Babb's Mill,** Greene Co., Tennessee. Iron. Nickel-rich ataxite. Morradal group. Polished slab. Cat. No. 109.	70
		Etched slab with crust. Cat. No. 906.	47
		Etched slab. Etching produces minute pits. Cat. No. 904.	45
		Polished slab with crust. Cat. No. 905.	43
41	Fell 1814 Feb. 15 Noon	**Bachmut,** (Alexejewka), Ekaterinoslaw, Russia. Stone. White chondrite. Sawed slab with crust and polished surface. Cat. No. 1379.	26
		Fragment with crust and polished surface. Cat. No. 234.	12
42	Found 1871	**Bacubirito** (Ranchito), Sinaloa, Mexico. Iron. Finest octahedrite. Thick, etched slab. 7x15 cm. Cat. No. 1124.	1,445
		Thick, etched mass. Cat. No. 537.	352
43	Found 1891	**Bald Eagle,** Lycoming Co., Pennsylvania. Iron. Medium-octahedrite. Full-sized section, etched. Figured by Ward. Cat. of 1904, Plate VII. Cat. No. 1006.	300
44	Found 1893	**Ballinoo,** West Australia. Iron. Finest octahedrite. Section 145x263 mm. with crust. The crust surface shows three of the circular depressions typical of this iron. They appear to be related to corresponding troilite inclusions. Cat. No. 979.	8,390
		End piece, 70x150 mm. etched. Cat. No. 980.	2,721
45	Fell 1871 Dec. 10 1:30 P. M.	**Bandong,** Java. Stone. Rodite. Mass with crust. Interior blue-gray, fine-grained. Crust black, thin. Cat. No. 1753.	17
		Mass from interior. Of lighter color than the preceding. Cat. No. 1754.	8
		Two fragments from interior. Cat. No. 304.	1
46	Fell 1790 July 24 9 P. M.	**Barbotan,** Gascony, France. Stone. Veined gray chondrite. Mass with crust and polished surface. Color brownish-gray. Cat. No. 1844.	315
		Mass with crust. Cat. No. 214.	130
		Fragment from interior. Cat. No. 213.	6
47	Fell 1842 July 4	**Barea,** Logrono, Spain. Iron-stone. Mesosiderite. Fragment with polished surface. Cat. No. 1264.	5
		Fragment. Cat. No. 1265.	2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
48	Found 1855	**Barranca Blanca,** Chile. Iron. Brecciated octahedrite. Fragment 13x24 cm. with torn and etched surfaces. Figures irregular. Cat. No. 1085.	16
49	Found 1852	**Barratta,** New South Wales. Stone. Intermediate chondrite. Nearly complete individual. One surface polished. This is the largest known individual of the fall. It is well oriented, the direction of movement having been at right angles to the longest axis of the mass. See Plates LX and LXI. Cat. No. 1465.	72,348
		Nearly complete individual. One surface polished. Cat. No. 1464.	16,761
		Full-sized, polished section 22x54 cm. A strong tendency to "sweating" is noticeable. Cat. No. 1463.	3,402
		Full-sized, polished section. Cat. No. 1462.	1,435
		Full-sized, polished section 10x15 cm. Cat. No. 539.	295
50	Fell 1892 Aug. 29	**Bath,** Brown Co., South Dakota. Stone. Brecciated spherical chondrite. Section 53x115x140 mm. with polished surfaces. Cat. No. 1782.	1,700
		Mass with crust and armored surface. Cat. No. 351.	1,276
51	Fell 1902 Nov. 15 6:45 P. M.	**Bath Furnace,** Bath Co., Kentucky. Stone. Intermediate chondrite. Complete individual, the largest of the fall. It is strikingly oriented. Cat. No. 1332.	80,739
		End piece with crust. Polished. Cat. No. 1331.	3,061
		End piece with crust. Polished. Cat. No. 555.	366
		One half of a complete individual. Cat. No. 570.	88
52	Found 1866	**Bear Creek,** Jefferson Co., Colorado. Iron. Fine octahedrite. Etched section with crust on three sides. Cat. No. 1125.	62
		Fragment showing crust. Octahedral cleavage well displayed. Cat. No. 88.	43
		Thin slab, etched. The figures are well marked, the plates of taenite being very distinct. Cat. No. 89.	27
53	Fell 1893 May 26 3:30 P. M.	**Beaver Creek,** West Kootenai District, British Columbia. Stone. Crystalline spherical chondrite. Mass with crust and polished surface. Cat. No. 1393.	1,103
		Mass with crust. Cat. No. 1392.	575
		Mass from interior. Cat. No. 1391.	229
		Mass with crust. Cat. No. 1390.	165
		Mass with crust. Cat. No. 353.	19
		Fragment with crust. Cat. No. 352.	1

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Bella Roca, Durango, Mexico.	
54	Found 1888	Iron. Fine octahedrite. Full-sized slab, 29x8 cm. etched. Shows large, elongated nodules of troilite and oriented veinings of schreibersite. Cat. No. 984.	745
		About half of slab next to previous. Characters similar. Cat. No. 985.	440
		Etched mass with crust. Cat. No. 611.	224
		Benares, N. W. Provinces, India.	
55	Fell 1798 Dec. 19 8 P. M.	Stone. Spherulitic chondrite. Mass with crust. Crust black, interior light-gray. Chondri not evident. Cat. No. 1505.	61
		Fragment with crust. Cat. No. 217.	1
		Bendego, Bahia, Brazil.	
56	Found 1784	Iron. Coarse octahedrite. Etched slab with crust. Cat. No. 5.	1,132
		Etched slab with crust. Cat. No. 897.	920
		Etched slab with elongated troilite. Cat. No. 6.	855
		Etched slab with crust. Figures dimly outlined. Cat. No. 896.	735
		Berlanguillas, Burgos, Spain.	
57	Fell 1811 July 8 8 P. M.	Stone. Veined intermediate chondrite. Fragment with crust. Cat. No. 1756.	10
		Fragment from interior with polished surface. Cat. No. 1757.	9
		Polished fragment. Texture firm. Abundant metallic grains. Cat. No. 492.	5
		Bethany, Great Namaqua Land, Africa.	
58	Found 1838	Iron. Finest octahedrite. The writer follows Cohen (Meteoritenkunde, Heft III) in grouping Mukerop, Lion River, Great Fish River and Springbok River under the name Bethany. Fragment with crust. Cat. No. 1028.	4
		Great Fish River. Fragment. Cat. No. 1029.	11
		Springbok River. Etched fragment. Cat. No. 1030.	10
		Thin shaving, etched. Cat. No. 825.	2
		Lion River. Etched slab. Cat. No. 1032.	215
		Etched slab. Cat. No. 376.	62
		Etched slab. Cat. No. 1031.	45
		Etched slab. Cat. No. 62.	27
		Mukerop. Mass with crust and two etched surfaces. Cat. No. 1033.	22,650
		Full-sized section, 36x69 cm. etched. Cat. No. 1034.	20,411
		Etched slab, with figures differing on two sides of a median line. Cat. No. 569.	429
		Etched slab. Cat. No. 1035.	293
		Etched slab. Cat. No. 552.	10
		Amalia. Full-sized section, 33x37 cm. etched. "Faulting" is well shown. Cat. No. 789.	9,460

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
59	Fell 1859 Aug. 11 7:30 A. M.	**Bethlehem,** Albany Co., New York. Stone. Crystalline spherulitic chondrite. Fragment from interior. Cat. No. 1843.	1
60	Fell 1859 May	**Beuste,** Basses Pyrénées, France. Stone. Brecciated gray chondrite. Full-sized section with crust. One side polished. The brecciated structure is well shown. Cat. No. 1568.	37
61	Fell 1827 Oct. 5 9:30 A. M.	**Bialystock,** Bialystock, Russia. Stone. Howardite. Fragment from interior. Light-colored, friable. Cat. No. 1563.	5
62	Fell 1887 Jan. 1 6 P. M.	**Bielokrynitschie,** Volhynia, Russia. Stone. Brecciated intermediate chondrite. Complete individual. Cat. No. 1394. Polished slab from interior. Cat. No. 1395. Fragment with crust. Cat. No. 1396. Polished fragment with crust. Cat. No. 484.	257 34 22 9
63	Found 1905	**Big Skookum Gulch,** Yukon, Alaska. Iron. Nickel-rich ataxite. Etched section. Cat. No. 1963.	728
64	Found 1903	**Billings,** Christian Co., Missouri. Iron. Medium octahedrite. About one-fourth the original mass. Polished and etched. Cat. No. 1098. Full-sized, etched section. Cat. No. 1097. Etched section. Cat. No. 601.	11,906 843 521
65	Found 1880	**Bingara,** New South Wales. Iron. Granular hexahedrite. Shavings. Cat. No. 1078.	1
66	Found 1888	**Bischtübe,** Turgai, Russia. Iron. Coarse octahedrite. Full-sized etched section. Cat. No. 913. Complete individual. Cat. No. 912. Thin slab from interior. Etched. Figures much like those of a medium octahedrite. Cat. No. 914.	1,814 630 37
67	Found 1912	**Bishop Canyon,** San Miguel Co., Colorado. Iron. Fine octahedrite. Complete individual. Cat. No. 1955. Etched fragment. Cat. No. 1948.	8,607 42
68	Fell 1843 Mar. 25	**Bishopville,** Sumter Co., South Carolina. Stone. Veined chladnite. Fragments showing crust. Cat. No. 1886. Fragments from interior. Cat. No. 1888. Fragments from interior. Cat. No. 1887. Fragments with and without crust. Cat. Nos. 251–3.	34 27 18 8

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
69	Fell 1895 April 26 3 P.M.	**Bishunpur,** N. W. Provinces, India. Stone. Black chondrite. Fragment with crust. Shows white chondri in dark matrix. Cat. No. 1537.	1
70	Found 1862	**Bitburg,** (Albacher Mühle), Rhenish Prussia. Iron-stone. Pallasite. Porous slab with one surface 6x9 cm. polished. Cat. No. 1259.	572
		Porous mass 4x4 cm. containing grains of charcoal. Cat. No. 1258.	206
		Porous slab with one surface polished. Cat. No. 1257.	186
		Mass with crust and polished surfaces. Cat. No. 31.	72
		Polished porous slab. Cat. No. 30.	22
71	Fell 1796 Jan. 15	**Bjelaja Zerkov,** Kief, Russia. Stone. Spherulitic chondrite. Fragments with crust. Crust black, interior rusty brown. Cat. No. 1416.	7
72	Fell 1899 Mar. 12 10:30 P. M.	**Bjürböle,** Finland. Stone. Spherical chondrite. Mass with crust. Cat. No. 1428.	4,983
		Mass with crust. Cat. No. 1427.	906
		Mass with crust. Shows angular inclusions of a finer grain. Cat. No. 522.	310
		Mass from interior. Shows vein of troilite. Cat. No. 1426.	86
73	Found 1835	**Black Mountain,** Buncombe Co., North Carolina. Iron. Coarse octahedrite. Several octahedral fragments. Cat. No. 1080.	7
74	Fell 1909 May 30 10:30 P. M.	**Blanket,** Brown Co., Texas. Stone. Complete individual. Cat. No. 1964.	1,632
		Complete individual. Cat. No. 1965. Gift of Stanley Field and Arthur B. Jones. See Plate LXII.	1,516
75	Fell 1833 Nov. 25 6:30 P. M.	**Blansko,** Moravia, Austria. Stone. Veined gray chondrite. Nearly complete individual. One polished surface. Metal abundant. Cat. No. 1571.	11
76	Found 1890	**Blue Tier,** Tasmania. Iron. Medium octahedrite. Etched fragment 14x19 mm. with oxidized surface. Figures not well marked. Cat. No. 952.	9

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
77	Found 1878	**Bluff,** Fayette Co., Texas. Stone. Brecciated crystalline chondrite. End piece, with polished surface 25x35 cm. Alteration extends inward from the crust about 1 cm. Cat. No. 173. Complete individual. This is a crusted fragment of a much larger individual. A primary crust is shown on a relatively small surface. The remainder of the crust is secondary. The surface is much reddened by oxidation. See Plate LXIV. Cat. No. 1461. Full-sized, polished section, 27x55 cm. Cat. No. 1460. Full-sized, polished section 30x46 cm. Cat. No. 1459. Polished section 31x38 cm. showing the characteristic veins of the meteorite. Cat. No. 174.	10,985 8,619 7,483 5,556 2,934
78	Fell 1804 Nov. 24	**Bocas,** San Luis Potosi, Mexico. Stone. White chondrite. Fragment with crust. Interior veined. Cat. No. 1497.	1
79	Found 1829	**Bohumilitz,** Bohemia. Iron. Coarse octahedrite. Full-sized, etched section, 13x22 cm. Cat. No. 899. Etched slab with crust. Cat. No. 487. Thin slab, etched. Cat. No. 898.	1,559 275 48
80	Fell 1808 April 19 Noon	**Borgo San Donino,** Cusignano, Italy. Stone. Howarditic chondrite. Fragment with crust. Large grains of troilite and dark-gray bronzite chondri are noticeable. Cat. No. 1530. Interior fragment. Cat. No. 1531.	6 5
81	Fell 1894 May 9 4 P. M.	**Bori,** Betul, India. Stone. Veined intermediate chondrite. Mass 5x5x7 cm. with crust. The texture is noticeably coarse. Cat. No. 1382.	497
82	Fell 1852 Oct. 13 3 P. M.	**Borkut,** Marmaros, Hungary. Stone. Spherical chondrite. Sawed fragment with crust. Texture coarse. Color dark gray. Cat. No. 1555.	78
83	Fell 1812 Sept. 5 1 A. M.	**Borodino,** Moscow, Russia. Stone. Brecciated gray chondrite. Fragment with crust. Polished. Firm texture, rusty brown color. Cat. No. 1420.	1
84	Found 1823	**Botschetschki,** Kursk, Russia. Stone. Gray chondrite. Slice 2x3 cm. from interior, two sides polished. Color so dark that the meteorite appears like a black chondrite. Cat. No. 1570.	11

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
85	Found 1810	**Brahin,** Minsk, Russia.	
		Iron-stone. Pallasite. Slab with polished surface. Cat. No. 1318.	53
		Torn mass. Cat. No. 1319.	32
86	Fell 1847 July 14 3:45 A. M.	**Braunau,** Hauptmannsdorf, Bohemia.	
		Iron. Hexahedrite. Wedge-shaped mass from interior. Shows cubic cleavage. Cat. No. 908.	278
		Etched slab with crust. Three faces etched. One shows grains of different sheen with Neumann lines running in different directions. Cat. No. 907.	106
		Mass with crust. Cat. No. 604.	50
		Sawed block showing natural surface with pits. The crust surface has the color of blued steel. Cat. No. 55.	47
87	Fell 1855 May 13 5 P. M.	**Bremervörde,** (Gnarrenburg), Hannover, Germany.	
		Stone. Brecciated spherical chondrite. Fragment with crust and polished surface. The polished surface is gray, mottled with white chondri and irregular metallic grains, some of them large. Crust black, thin. Cat. No. 438.	72
		Fragment with crust. Cat. No. 1758.	17
88	Found 1882	**Brenham,** Kiowa Co., Kansas.	
		Iron-stone. Pallasite. Complete individual, the largest of the fall. Form roughly heart-shaped. Cat. No. 200.	218,847
		Complete individual. Almost wholly iron. Kidney-shaped. Cat. No. 204.	155,473
		End piece of large individual. One polished surface. Cat. No. 1278.	44,905
		Complete individual of spheroidal form. Almost wholly iron. Cat. No. 205.	16,091
		End piece with polished surface, 27x34 cm. Cat. No. 1277.	12,684
		End piece with polished surface, 16x31 cm. Cat. No. 1276.	9,966
		Full-sized section, polished. Cat. No. 203.	8,490
		Complete individual. Form hemispheroidal. Cat. No. 202.	8,049
		Full-sized section, polished. The chrysolite is exceptionally transparent. Cat. No. 198.	4,977
		Thin, broad section, 16x36 cm. Polished. Cat. No. 1275.	3,171
		One-half of a complete individual, one surface polished. Cat. No. 195.	1,971
		Full-sized section, polished. Cat. No. 201.	1,662
		Full-sized section, polished. Cat. No. 197.	1,653
		Full-sized section, polished. The central portion for a width of about 5 cm. is solid metal, but on either side the pallasite structure occurs. Cat. No. 196.	1,248
		Cuboidal section with crust. Cat. No. 1274.	1,162

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams
		Brenham, Kiowa Co., Kansas.—Continued.	
88	Found 1882	Cuboidal section 5x5x8 cm. with crust. Cat. No. 1273.	768
		Full-sized, etched section showing transition from siderite to pallasite. Cat. No. 1272.	587
		Polished section. Cat. No. 199.	418
		Full-sized, etched section showing transition from siderite to pallasite. Cat. No. 1271.	410
		Section. Cat. No. 450.	165
		Etched section. Cat. No. 432.	160
		Section. Cat. No. 436.	31
		Bridgewater, Burke Co., North Carolina.	
89	Found 1890	Iron. Fine octahedrite. Etched slab with crust. Cat. No. 1895.	83
		Etched slab with crust. Cat. No. 137.	19
		Burlington, Otsego Co., New York.	
90	Found before 1819	Iron. Medium octahedrite. Etched slab from interior, cut nearly parallel to cubic directions. Bands swollen. Cat. No. 915.	61
		Wedge-shaped, etched section, showing cleavage. Cat. No. 916.	62
		Buschhof, Kurland, Russia.	
91	Fell 1863 June 23 7:30 A. M.	Stone. Veined white chondrite. Mass with crust. Cat. No. 774.	37
		Mass with crust. Cat. No. 1473.	22
		Fragment from interior. Fine-grained and friable. Cat. No. 1475.	16
		Bustee, Goruckpur, India.	
92	Fell 1852 Dec. 2	Stone. Bustite. Fragments. Cat. No. 1352.	5
		Butler, Bates Co., Missouri.	
93	Found before 1874	Iron. Finest octahedrite. Etched slab with crust. Cat. No. 1122.	326
		Etched slab with crust. The characteristic figures of this iron are well shown. Cat. No. 1121.	110
		Etched slab containing nodules of troilite. Cat. No. 96.	71
		Butsura, Goruckpur, India.	
94	Fell 1861 May 12 about noon	Stone. Intermediate chondrite. Polished slab with crust. Color dark brown. Metal abundant. Takes a good polish. Cat. No. 1884.	27
		Fragment with crust and polished surface. Cat. No. 1885.	11
		Fragments with crust. Cat. No. 277.	2
		Cabezzo de Mayo, Murcia, Spain.	
95	Fell 1870 Aug. 18 6:15 A. M.	Stone. White chondrite. Mass with crust. Cat. No. 1514.	102
		Mass with crust. Cat. No. 1515.	6(

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
96	Fell 1886 Mar. 27 3 P. M.	**Cabin Creek,** Johnson Co., Arkansas. Iron. Medium octahedrite. Etched fragment with crust on one side. Cat. No. 1091.	1
97	Found 1867	**Cacaria,** Durango, Mexico. Iron. Hammond octahedrite. Mass with crust and three etched surfaces. The crust surface is bright and smooth. Cat. No. 922.	1,586
		Etched slab with crust. Cat. No. 923.	383
		Etched slab with crust. Cat. No. 521.	180
		The above sections were all labelled Rancho de la Pila, but as they are Hammond octahedrites they are believed by the writer to be Cacaria. See Rancho de la Pila.	
98	Found 1874	**Cachiyuyal,** Atacama, Chile. Iron. Medium octahedrite. End piece with etched surface. The bands on the etched surfaces are long and straight. The crust surface shows the deep furrows characteristic of some of the Chilian irons. Cat. No. 958.	760
99	Found 1818	**Cambria,** Niagara County, New York. Iron. Fine octahedrite. Thin, broad, etched slab. Two included troilite nodules have borders of schreibersite. Cat. No. 928.	100
		Etched slab. The bands are both long and short and have wavy outlines. Cat. No. 927.	80
100	Found 1783	**Campo del Cielo,** Gran Chaco, Argentina. Iron. Ataxite. Section 16x6 cm. with crust border. Contains graphite and troilite nodule. Cat. No. 1016.	on 532
		Smaller section from adjoining part of mass. Cat. No. 1017.	261
101	Fell 1861 May 14 1 P. M.	**Canellas,** Barcelona, Spain. Stone. Intermediate chondrite. Fragment with crust. Cat. No. 1793.	7
		Fragment from interior. Cat. No. 1794.	2
102	Fell 1866 Dec. 6	**Cangas de Onis,** Oviedo, Spain. Stone. Brecciated gray chondrite. Nearly complete individual with crust broken from one end. Cat. No. 1842.	54
		Part of a small individual. Cat. No. 1841.	40
103	Found 1894.	**Canton,** Cherokee County, Georgia. Iron. Coarsest octahedrite. Full-sized section, etched. Bands long and of uniform width. A circular nodule of troilite 2 cm. in diameter is present. Cat. No. 1093.	158
		Fragment from interior. One surface polished. Cat. No. 1092.	110
104	Found 1875	**Canyon City,** Trinity Co., California. Iron. Medium octahedrite. End piece, etched. Cat. No. 1019.	4,223
		Full-sized section, etched. Bands long and straight, fields few. Cat. No. 1018.	412

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Canyon Diablo, Conconino Co., Arizona.	
105	Found 1891	Iron. Coarse octahedrite. Complete individual. Flattened form. Cat. No. 143.	460,304
		Complete individual. Conical form and perforated. Cat. No. 1233.	383,292
		Complete individual. Cat. No. 1234.	252,202
		Complete individual. Cat. No. 1235.	169,553
		Complete individual. Cat. No. 1236.	143,791
		Complete individual. Perforated. Cat. No. 146.	120,657
		Complete individual. Cat. No. 1237.	100,919
		Complete individual. Cat. No. 149.	90,898
		Complete individual. Cat. No. 1238.	72,575
		Complete individual. Cat. No. 1239.	67,586
		Complete individual. Cat. No. 1240.	58,968
		Complete individual. Cat. No. 1241.	53,070
		End piece, etched. Cat. No. 1244.	48,080
		Complete individual. Cat. No. 1242.	44,451
		Complete individual. Gift of Edward E. Ayer Pioneer Hose Company. Cat. No. 497.	34,800
		End piece, etched. Cat. No. 1245.	31,752
		Complete individual. Cat. No. 1243.	26,308
		Thick slab, 20x27 cm., polished. Shows nodules of troilite. Cat. No. 150.	26,047
		Nearly complete individual. One polished surface. Cat. No. 151.	24,489
		Nearly complete individual. Cat. No. 148.	23,596
		Etched section, 35x46 cm. Cat. No. 1246.	18,597
		Etched section, 35x52 cm. Cat. No. 1247.	17,238
		One hundred individuals ranging from 900 to 25 grams each in weight. Cat. No. 1252.	15,649
		Etched section, 18x40 cm. Cat. No. 1248.	10,279
		Etched section, 19x30 cm. Cat. No. 147.	4,309
		Etched section, 20x29 cm. Cat. No. 144.	2,934
		Etched section. Cat. No. 1249.	1,247
		Complete individual. Cat. No. 141.	844
		Complete individual. Cat. No. 373.	620
		Complete individual. Cat. No. 610.	200
		Complete individual. Cat. No. 145.	165
		Six fragments. Cat. No. 152.	123
		Etched section. Cat. No. 1251.	110
		Complete individual. Gift of George Bell. Cat. No. 455.	60
		Cape Girardeau, Cape Girardeau Co., Missouri.	
106	Fell 1846 Aug. 14 3 P.M.	Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1566.	43
		Mass with crust. Cat. No. 1567.	18
		Cape of Good Hope, Africa.	
107	Found 1793	Iron. Ataxite, with hexahedral streaks. Thin, broad slab, etched. Cat. No. 911.	169
		Polished slab with crust on one edge, luster dull. Cat. No. 912.	59
		Polished slab of brilliant nickel-white color. Cat. No. 29.	27

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
108	Found 1869	**Caperr,** Chubut, Patagonia. Iron. Medium octahedrite. Full-sized section, etched. A long, straight vein of some accessory mineral traverses this specimen. Cat. No. 1005.	383
109	Found 1818	**Cape York,** Greenland. Iron. Medium octahedrite. Shavings. Cat. No. 953.	6
110	Found 1888	**Carcote,** Atacama, Chile. Stone. Crystalline chondrite. Sawed fragment. Cat. No. 1492.	1
111	Found 1887	**Carlton,** Hamilton Co., Texas. Iron. Finest octahedrite. Full-sized, thin slab, 22x30 cm., showing polished and etched surfaces. The etching figures are beautifully distinct and appear as delicate lines running parallel in two directions throughout the mass. Schreibersite is distributed in radiating veins. Cat. No. 131.	3,406
		Full-sized, etched section. Cat. No. 879.	3,175
		Full-sized, etched section. Cat. No. 880.	2,721
112	Found 1840	**Carthage,** Smith Co., Tennessee. Iron. Medium octahedrite. Etched section with crust. Cat. No. 924.	447
		Thick slab showing polished and etched surface and crust. Coarse figures are dimly outlined. The lines of taenite are very delicate. Cat. No. 51.	50
		Caney Fork. Etched section with crust. Cat. No. 925.	15
113	Recognized 1867	**Casas Grandes,** Chihuahua, Mexico. Iron. Medium octahedrite. Broad slab, 24x41 cm. etched. Cat. No. 881..................	6,003
		Broad, etched slab. Cat. No. 882.	3,288
		Etched section, 12x13 cm. Cat. No. 524.	608
114	Found 1877	**Casey County,** Kentucky. Iron. Coarse octahedrite. Etched section in two parts. The kamacite masses are not as broad as in the following specimen. Cat. No. 1076.	42
		Etched section with crust. Both granular and hatched kamacite are present in broad masses. The structure of this iron should receive further study. Cat. No. 1075.	29
115	Fell 1874 May 14 2:30 P. M.	**Castalia,** Nash Co., North Carolina. Stone. Gray chondrite. Mass with crust and one sawed surface. Chondri are well shown. Cat. No. 1519.	185
		Fragment from interior. Cat. No. 308.	6
		Fragment with crust. Cat. No. 307.	1

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Castine, Hancock Co., Maine.	
116	Fell 1848 May 20 4 A. M.	Stone. Veined white chondrite. Mass with crust and polished surface. Crust smooth, interior coarse-grained and friable. Should be classed as a spherulitic chondrite. Cat. No. 1565.	42
		Central Missouri.	
117	Found 1885	Iron. Coarsest octahedrite. End piece with polished surface. Cat. No. 1059.	2,466
		Cereseto, Alessandria, Italy.	
118	Fell 1840 July 17 7:30 A. M.	Stone. Brecciated spherulitic chondrite. Fragment with crust and armoured surface. Cat. No. 1476.	9
		Chambord, Quebec, Canada.	
119	Found 1904	Iron. Medium octahedrite. Etched section with crust. Section cut nearly parallel to a cube. Cat. No. 921.	18
		Chañaral, Atacama, Chile.	
120	Found 1884	Iron. Medium octahedrite. End piece with etched surface. Cat. No. 939.	11
		Chandakapoor, Berar, India.	
121	Fell 1838 June 6 Noon	Stone. Brecciated intermediate chondrite. Mass with crust. Cat. No. 1800.	68
		Fragment from interior with two polished surfaces. The stone takes a good polish Cat. No. 1802.	12
		Three fragments from interior, two polished. Cat. No. 245.	3
		Chantonnay, Vendée, France.	
122	Fell 1812 Aug. 5 2 A. M.	Stone. Gray chondrite. Mass from interior. Cat. No. 1791.	51
		Mass from interior. Cat. No. 1790.	46
		Polished chip. Cat. No. 232.	2
		Charcas, San Luis Potosi, Mexico.	
123	Known 1804	Iron. Medium octahedrite. Broad, etched section. Cat. No. 931.	6,180
		Etched section with crust. Contains circular troilite nodules. Cat. No. 930.	1,473
		Charlotte, Dickson Co., Tennessee.	
124	Fell 1835 August 1 2–3 P. M.	Iron. Fine octahedrite. Thin slab, one surface etched. Cat. No. 40.	7
		Triangular section with crust. Etched. Cat. No. 923.	5
		Charsonville, Loiret, France.	
125	Fell 1810 Nov. 23 1:30 P. M.	Stone. Veined gray chondrite. Two fragments from interior, one with polished surface. Cat. No. 1489.	42
		Fragment from interior. Cat. No. 229.	22
		Fragment from interior showing broad, black vein. Cat. No. 1490.	13
		Thin chip, polished. Cat. No. 230.	2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
126	Fell 1834 June 12 8 A. M.	**Charwallas,** Punjaub, India. Stone. Intermediate chondrite. Fragments. Cat. No. 1832.	0.2
127	Fell 1815 Oct. 3 8 A. M.	**Chassigny,** Haute-Marne, France. Stone. Chassignite. Fragment from interior. Grayish-brown with white feldspar laths. If this is Chassigny it has characters which have not been hitherto described. Cat. No. 1780.	10
		Fragments from the interior. Composed of light-yellow friable chrysolite specked with black. Cat. No. 546.	7
128	Fell 1841 June 12 1:30 P. M.	**Chateau Renard,** Loiret, France. Stone. Veined intermediate chondrite. Mass with crust and armored surface running into a black vein which is a broad plane. Cat. No. 1804.	174
		Mass from interior. Cat. No. 1805.	65
		Fragment with crust and polished surface. Body color much darker than that of preceding specimen. Cat. No. 1806.	15
		Fragments from interior. Cat. Nos. 247–8.	12
129	Fell 1901 Nov. 30 2 P. M.	**Chervettaz,** Vaud, Switzerland. Stone. Crystalline spherical chondrite. Fragment with crust and polished surface. Chondri distinct. Cat. No. 1562.	27
130	Found before 1849	**Chesterville,** Chester Co., South Carolina. Iron. Ataxite. Etched slab with crust. Cat. No. 1077.	139
		Thin, etched slab. Cat. No. 56.	6
131	Found 1881	**Chilcat,** Alaska. Iron. Medium octahedrita. Etched section with crust. Cat. No. 1069.	62
132	Found 1902	**Chinautla,** Guatemala. Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 1949.	127
133	Found 1873	**Chulafinnee,** Cleburne Co., Alabama. Iron. Medium octahedrite. Etched slab with crust. Cat. No. 1109.	88
		Etched slab. Figures dim. Cat. No. 94.	29
134	Found 1852	**Chupaderos,** Chihuahua, Mexico. Iron. Fine octahedrite. End piece, etched. Cat. No. 1047.	5,386
		Full-sized, etched slab. Troilite and schreibersite are prominent constituents. Cat. No. 1045.	2,494
		Full-sized, etched slab. Cat. No. 1046.	2,409
		Etched mass with crust. Bands broader than in the other Chupaderos specimens. Cat. No. 1044.	295

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Cincinnati, Hamilton Co., Ohio.	
135	Found 1898	Iron. Ataxite. Etched fragment with crust. The minutely forked structure of the iron is well shown. Cat. No. 1089.	1
		Cleveland, Bradley Co., Tennessee. (Lea Iron.)	
136	Found 1860	Iron. Medium octahedrite. Large, thin slab, showing crust, polished and etched surfaces. Typical figures. Cat. No. 127.	234
		Etched slab. Figures distinct. Cat. No. 1196.	174
		Etched slab with crust. Cat. No. 1197.	95
		Coahuila, Mexico.	
137	Known 1837	Iron. Hexahedrite. Bolson de Mapimi. Broad slab, 15x33 cm. etched. Cat. No. 843.	2,069
		Thin, etched section. Cat. No. 844.	445
		Broad, thin slab. Cat. No. 845.	185
		Broad, thin section. Cat. No. 846.	157
		Bonanza. Etched slab with crust. Cat. No. 847.	1,191
		Etched slab. Cat. No. 848.	315
		Butcher Iron. Large segment with polished surface. Crust surface smooth. Cat. No. 43.	3,402
		Etched section. Cat. No. 841.	924
		Thin, polished slab, showing nodules of troilite. Cat. No. 42.	653
		Sancha Estate. Etched slab. Cat. No. 849.	163
		Etched slab. Cat. No. 850.	85
		Thin, polished slab, partly etched. Cat. No. 37.	70
		Turnings. Cat. No. 90.	10
		Santa Rosa. Full-sized, polished section. Cat. No. 851.	750
		Cobija, Antofagasta, Chile.	
138	Found 1882	Stone, Crystalline chondrite. End piece with polished surface. Cat. No. 1409.	1,100
		Polished section. Cat. No. 753.	120
		Cold Bokkeveld, Cape Colony, Africa.	
139	Fell 1838 Oct. 13 9 A. M.	Stone. Carbonaceous chondrite. Fragment with crust. Cat. No. 1736.	36
		Fragment with crust. Cat. No. 1737.	19
		Four fragments with crust, one from interior. Cat. No. 1738.	12
		Fragment from interior. Cat. No. 246.	1
		Colfax, near Ellenboro, Rutherford Co., North Carolina.	
140	Found 1880	Iron. Medium octahedrite. End piece, etched. Cat. No. 1960.	656
		End piece, etched. Cat. No. 1961.	193
		Etched fragment. Cat. No. 1117.	42
		Collescipoli, Terni, Italy.	
141	Fell 1890 Feb. 3 1:30 P. M.	Stone. Spherical chondrite. Mass with crust. Cat. No. 1532.	63
		Mass with crust. Cat. No. 1533.	44
		Fragment with crust. Cat. No. 356.	2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Coon Butte, Coconino Co., Arizona.	
142	Found 1905	Stone. Full-sized section, one surface polished. One light-colored chondrus is 9 mm. in diameter. Cat. No. 1434.	309
		Coopertown, Robertson Co., Tennessee.	
143	Known 1860	Iron. Medium octahedrite. Thin slab, etched. The bands are sometimes 5 mm. in thickness. Cat. No. 83.	82
		Etched section with crust. The bands are broad from being doubled in width. Cat. No. 1127.	60
		Etched section with crust on three edges. The bands are long with wavy outlines. Cat. No. 1126.	52
		Polished section. Cat. No. 822.	21
		Copiapo, (Sierra de Deesa), Atacama, Chile.	
144	Found 1863	Iron. Brecciated octahedrite. Surface section, etched. Cat. No. 833.	195
		Cosby's Creek, Cocke Co., Tennessee.	
145	Described 1840	Iron. Coarse octahedrite. Five octahedral fragments with plates of taenite. Cat. No. 53.	114
		Irregular fragment. Shows octahedral cleavage. Cat. No. 890.	58
		Irregular fragment. Shows octahedral cleavage. Cat. No. 49.	43
		Several irregular fragments. Cat. No. 48.	35
		Sevier County. Mass with crust. Cleavage prominent except on crusted surface. Cat. No. 891.	2,947
		Etched slab with crust. Cat. No. 889.	97
		Cosina, Guanajuato, Mexico.	
146	Fell 1844 Jan. 11 A. M.	Stone. Crystalline chondrite. Fragment with one sawed surface. Color dark gray. The chondri are so distinct that the meteorite should apparently be classified as a spherical chondrite. Cat. No. 1561.	5
		Costilla Peak, Taos Co., New Mexico.	
147	Found 1881	Iron. Medium octahedrite. Broad, etched section with crust. Cat. No. 857.	6,804
		Full-sized, etched section, 11x31 cm. Cat. No. 856.	1,700
		Nearly full-sized section, etched, 11x20 cm. Cat. No. 502.	1,154
		Cowra, Bathurst District, New South Wales.	
148	Found 1888	Iron. Finest octahedrite. Etched section. Cat. No. 783.	68
		Thin, broad section, etched. Schreibersite present in a vein-like mass. Cat. No. 973.	25

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Crab Orchard, Cumberland Co., Tennessee.	
149	Found 1887	Iron-stone. Mesosiderite. End piece with polished surface 17x26 cm. Cat. No. 187.	6,151
		Complete individual. The surface shows weathering. Cat. No. 185.	4,351
		Full-sized, polished section, 18x27 cm. Cat. No. 1263.	1,786
		End piece with polished surface. Cat. No. 374.	806
		End piece with polished surface, 12x13 cm. Cat. No. 186.	801
		End piece with polished surface. Cat. No. 1262.	605
		Polished fragment. Cat. No. 1261.	45
		Etched section. Cat. No. 184.	40
		Cranberry Plains, Giles Co., Virginia.	
150	Found 1852	Iron. Octahedrite. Fragment. Cat. No. 1084.	2
		Cranbourne, Victoria, Australia.	
151	Found 1854	Iron. Coarse octahedrite. Full-sized, etched section. Cat. No. 1199.	1,586
		Decomposed fragment. Plates of taenite are distinguishable. Cat. No. 68.	34
		Interior fragment with octahedral structure. Cat. No. 1198.	23
		Cleavage fragment. Cat. No. 69.	4
		Beaconsfield.	
	Described 1887	Full-sized, etched section, 100x120 mm. Cat. No. 1159.	772
		Etched section showing distinct figures. Contains two troilite nodules each rimmed by schreibersite. Cat. No. 499.	413
		Yarra Yarra River.	
		Thin etched slab. Figures are indicated but are not distinct. Cat. No. 70.	15
		Cronstadt, Orange Free State, Africa.	
152	Fell 1877 Mar. 9	Stone. Veined gray chondrite. Fragment with crust. Metal segregated near crust. Cat. No. 1546.	6
		Slice with crust. Cat. No. 1547.	4
		Cross Roads, Wilson Co., North Carolina.	
153	Fell 1892 May 24 5 A. M.	Stone. Gray chondrite. Mass with crust. Color dark-gray, texture firm. Cat. No. 1559.	18
		Crumlin, County Antrim, Ireland.	
154	Fell 1902 Sept. 13 10:30 A. M.	Stone. Gray chondrite. Fragment with crust and armored surface. Texture firm. Cat. No. 1499.	13
		Cuba, West Indies.	
155	Found 1872	Iron. Medium octahedrite. Oxidized fragments. Cat. No. 1087.	3

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
156	Found 1889	**Cuernavaca,** Morelos, Mexico. Iron. Fine octahedrite. End piece with two polished surfaces. Schreibersite in hieroglyphic forms is a prominent feature. Cat. No. 1025. Full-sized slab, etched. Shows large, circular nodules of troilite and long, straight veins of schreibersite which run at angles near 90°. Cat. No. 1024.	17,359 338
157	Found 1911	**Cullison,** Pratt Co., Kansas. Stone, Crystalline chondrite. Thin, broad slab with crust and polished surface. Metal abundant. Cat. No. 1746.	154
158	Fell 1877 Jan. 23 4 P. M.	**Cynthiana,** Harrison Co., Kentucky. Stone. Gray chondrite. Five fragments with crust. Cat. No. 1504.	22
		Dakota, see Ponca Creek.	
159	Found 1879	**Dalton,** Whitfield Co., Georgia. Iron. Medium octahedrite. Etched section. Cat. No. 1967.	92
160	Fell 1878 Sept. 5	**Dandapur,** Goruckpur, India. Stone. Veined intermediate chondrite. Sawed mass from interior. Cat. No. 1548. Fragment with crust, one surface polished. Cat. No. 449.	65 27
161	Fell 1868 Mar. 20	**Daniel's Kuil,** Griqualand, West Africa. Stone. Crystalline chondrite. Polished slice and fragment with crust. Color dark brown. Metal abundant. Cat. No. 1500.	16
162	Fell 1868 Nov. 27 5 P. M.	**Danville,** Morgan Co., Alabama. Stone. Veined gray chondrite. Fragment from interior. Cat. No. 1578.	5
163	Found 1903	**Davis Mountains,** Jeff Davis Co., Texas. Iron. Medium octahedrite. Individual, complete except for a small piece cut from a projecting corner. The mass is shield-shaped, dimensions 78x68x38 cm. Oriented. Front surface striated and somewhat smoothed. Cat. No. 1946.	690,000
164	Fell 1829 Aug. 14 11:30 P. M.	**Deal,** Monmouth Co., New Jersey. Stone. Intermediate chondrite. Fragment from interior. Veined. Cat. No. 1543.	0.5
165	Fell 1887 Jan. 21 2 P. M.	**De Cewsville,** Ontario, Canada. Stone. White chondrite. Fragment from interior. Cat. No. 1558.	0.2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Deep Springs, Rockingham Co., North Carolina.	
166	Found 1846	Iron. Nickel-rich ataxite. Morradal group. Full-sized, etched section, 8x20 cm. The section is somewhat porous from the decomposition of troilite. Cat. No. 883.	690
		Nearly complete, etched section, 7x17 cm. Exhibits no figures, but shows a few troilite inclusions. Cat. No. 453.	420
		Etched fragment with crust. Cat. No. 884.	46
		Delegate, Australia.	
167		Iron. Medium octahedrite. Etched section. Cat. No. 1969.	370
		Dellys, Algeria.	
168	Found 1865	Iron. Medium octahedrite. Two irregular fragments, one etched. Cat. No. 1064.	3
		Denton County, Texas.	
169	Found 1856	Iron. Medium octahedrite. Pyramidal fragment with crust. Etched. Cat. No. 1190.	25
		Thin slab with crust on edge. Etched. Shows long bands. Cat. No. 1191.	17
		Thin slab. Cat. No. 74.	3
		Descubridora, San Luis Potosi, Mexico.	
170	Found 1780	Iron. Medium octahedrite. Pyramidal mass with one etched surface. This surface has the form of an equilateral triangle 28 cm. on a side. The crust surface is undulating. Cat. No. 947.	28,576
		Full-sized, triangular, etched section. Cat. No. 948.	4,677
		Etched slab. Cat. No. 2.	35
		Catorce. Etched slab. Bands long and nearly parallel with edge of section. Cat. No. 949.	41
		Dhulia, Bombay, India.	
171	Fell 1877 Nov. 27 6 P. M.	Stone. Veined white chondrite. Fragment from interior. Light-colored, friable. Cat. No. 1544.	1
		Fragments of dark glass perhaps from crust. Cat. No. 1545.	1
		Dhurmsala, Punjaub, India.	
172	Fell 1860 July 14 2:15 P. M.	Stone. Intermediate chondrite. Mass with crust. Cat. No. 1348.	1,415
		Mass with crust. There is a light-colored inclusion. Cat. No. 1347.	985
		Mass with crust. Cat. No. 1346.	500
		Fragment from interior. Cat. No. 275.	5
		Djati Pengilon, Ngawi, Java.	
173	Fell 1884 Mar. 19 4:15 A. M.	Stone. Crystalline chondrite. Mass with crust (?) and sawed surfaces. The structure is very compact and crystalline. Cat. No. 1556.	28
		Like previous specimen. Cat. No. 1557.	11

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Dokachi, Bengal, India.	
174	Fell 1903 Oct. 22 7 P. M.	Stone. Spherical chondrite. Nearly complete individual with polished surface. Metal abundant in minute grains. Cat. No. 1380.	193
		Mass with crust. Cat. No. 772.	25
		Dolgowoli, Volhynia, Russia.	
175	Fell 1864 June 26 7 A. M.	Stone. White chondrite. Fragment from interior. Cat. No. 1509.	7
		Doña Inez, Atacama, Chile.	
176	Found 1888	Iron-stone. Mesosiderite. Complete individual. Cat. No. 193.	741
		Complete individual. Cat. No. 1291.	269
		Complete individual. Cat. No. 194.	245
		Complete individual. Cat. No.1292.	228
		End piece, polished. Cat. No. 1294.	55
		Etched section. Figures are shown on one metallic nodule. Cat. No. 191.	48
		Complete individual. Cat. No. 1293.	45
		Polished slab. Cat. No. 1295.	23
		Polished slab. Cat. No. 1296.	20
		Dores dos Campos Formosos, Brazil.	
177	Fell 1903 June 29 10 A. M.	Stone. Veined spherulitic chondrite. Cuboidal mass with crust on three sides. Crust reddish. Cat. No. 1528.	147
		Doroninsk, Irkutsk, Siberia.	
178	Fell 1805 April 6 5 P. M.	Stone. Brecciated gray chondrite. Mass with crust. The specimen shows characters typical of its class. Cat. No. 1560.	53
		Drake Creek, Sumner Co., Tennessee.	
179	Fell 1827 May 9 4 P. M.	Stone. Veined white chondrite. Mass with crust. Crust crackled, interior friable. Cat. No. 1526.	120
		Fragment with crust. Shows more oxidation and chondri than previous specimen. Cat. No. 1527.	9
		Duel Hill, Madison Co., North Carolina.	
180	Found 1873	Iron. Coarse octahedrite. Etched slab with crust on edge. Cat. No. 864.	178
		Etched section with crust on one edge. Cat. No. 865.	13
		Dundrum, Tipperary Co., Ireland.	
181	Fell 1865 Aug. 12 7 P. M.	Stone. Crystalline chondrite. Fragment from interior, showing loose, vitreous texture. Cat. No. 1501.	1
		Durala, Punjaub, India.	
182	Fell 1815 Feb. 18 Noon	Stone. Veined intermediate chondrite. Sawed fragment with crust. Crust thick, dark and blebby. Cat. No. 559.	54
		Sawed fragment with crust. Cat. No. 1542.	25

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Duruma, Wanikaland, Africa.	
183	Fell 1853 Mar. 6	Stone. Fragment from interior. Cat. No. 1552.	5
		Dyalpur, Oudh, India.	
184	Fell 1872 May 8	Stone. Ureilite. Fragments, one polished. Black and friable. Cat. No. 1541.	1
		Eagle Station, Carroll Co., Kentucky.	
185	Found 1880	Iron-stone. Pallasite. Polished slab. Cat. No. 1314.	180
		Sawed slab, showing deeply pitted natural surface and polished surface. The iron matrix encloses fragments of chrysolite, some a centimeter in diameter, transparent and of brilliant luster. Cat. No. 180.	106
		Polished slab. Cat. No. 1315.	100
		Polished slab. Cat. No. 1316.	60
		Elbogen, Bohemia.	
186	Fell 1400? Recognized 1811	Iron. Medium octahedrite. Lath-shaped section from interior, etched. Cat. No. 919.	43
		Section with polished and oxidized surfaces. On the polished surface the word "Elbogen" is engraved. Cat. No. 920.	20
		Etched fragment. Cat. No. 1.	2
		El Capitan, Lincoln Co., New Mexico.	
187	Found 1893	Iron. Medium octahedrite. Full-sized, etched section. The section shows many partings. Cat. No. 969.	1,615
		Full-sized, etched section. Cat. No. 968.	782
		Etched section with crust. Cat. No. 828.	137
		Eli Elwah, New South Wales.	
188	Found 1889	Stone. Chondrite. Polished slab with crust. Cat. No. 779.	81
		Two fragments with crust. Much more oxidized than preceding. Cat. No. 1343.	3
		Elm Creek, Lyon Co., Kansas.	
189	Found 1906	Stone. Spherical chondrite. Full-sized section. one surface polished. Cat. No. 765.	386
		Full-sized section, 11x22 cm., one surface polished. Cat. No. 1415.	380
		El Tule, Chihuahua, Mexico.	
190	Found 1889	Iron. Medium octahedrite. Etched fragment showing brilliant octahedral figures. Cat. No. 955.	9
		Emmitsburg, Frederick Co., Maryland.	
191	Found 1854	Iron. Medium octahedrite. Etched slab with crust. Cat. No. 67.	28
		Etched slab. Kamacite shows hatching. Cat. No. 1181.	21
		Etched slab with crust. Cat. No. 1182.	15

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Ensisheim, Upper Alsace, Germany.	
192	Fell 1492 Nov. 16 11:30 P. M.	Stone. Crystalline chondrite. Two masses with polished surfaces. The stone takes a good polish. Metallic grains few and mostly troilite. Cat. No. 1740.	58
		Mass with crust and armored surface. Crust color of interior. Cat. No. 1739.	36
		Fragment from interior. Cat. No. 207.	22
		Fragment from interior. Cat. No. 208.	4
		Epinal, Vosges, France.	
193	Fell 1822 Sept. 13 7 A. M.	Stone. Spherulitic chondrite. Mass from interior. Cat. No. 1787.	12
		Fragment with crust. Cat. No. 1786.	7
		Ergheo, Somaliland Peninsula, Africa.	
194	Found 1889	Stone. Crystalline chondrite. Polished section with crust. Alteration from the crust inward has extended in some places to a depth of 5 mm. making the claim that the meteorite was seen to fall in July, 1889, seem doubtful. Cat. No. 1769.	399
		Polished section with crust. Polished surface brownish-black, showing small metallic grains, rather thinly distributed. Texture firm, compact. Crust surface smooth and of reddish-brown color, indicating long exposure. Cat. No. 553.	192
		Erxleben, Saxony, Germany.	
195	Fell 1812 April 15 4 P. M.	Stone. Crystalline chondrite. Broad fragment with crust. Cat. No. 1772.	49
		Fragment from interior. Cat. No. 231.	2
		Esnandes, Charente-Inferieure, France.	
196	Fell 1837 Aug. 3	Stone. Gray chondrite. Fragment from interior. Dark, compact and contains a dark inclusion. Cat. No. 1569.	23
		Espiritu Santo, Michoacan, Mexico.	
197	Found(?)	Iron. Fine octahedrite. Etched fragment with crust. Fine octahedral figures are clearly shown. Cat. No. 1056.	54
		Estacado, Hale Co., Texas.	
198	Found 1902	Stone. Crystalline chondrite. About one-third the original mass. Has two broad, polished surfaces. Cat. No. 1439.	103,200
		Full-sized slab with polished surfaces. Cat. No. 760.	15,402

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Estherville, Emmet Co., Iowa.	
199	Fell 1879 May 10 5 P. M.	Iron-stone. Mesosiderite. Full-sized section, 18x37 cm., one surface polished. Cat. No. 1302.	4,965
		Full-sized section, 18x31 cm., one surface polished. Cat. No. 177.	2,721
		One hundred and fourteen complete individuals. Cat. No. 1308.	870
		Cuboidal section with crust. Cat. No. 1303.	489
		Stony mass with crust. Cat. No. 1305.	240
		Thin, broad, polished slab. Cat. No. 1304.	135
		Irregular fragment. Cat. No. 176.	75
		Thirteen complete individuals. Cat. No. 178.	47
		Two individuals. Cat. No. 1306.	25
		Twelve small individuals. Cat. No. 1307.	23
		Complete individual. Gift of A. E. J. Svege. Cat. No. 458.	1
		Farmington, Washington Co., Kansas.	
200	Fell 1890 June 25 1 P. M.	Stone. Black chondrite. End piece of 84 kg. individual. One surface, 15x40 cm. polished. Cat. No. 347.	13,365
		Two full-sized sections. Cat. No. 1820.	6,804
		Full-sized section. Cat. No. 346.	3,302
		Full-sized section, 20x33 cm. showing metallic veins. Cat. No. 348.	2,792
		Nearly encrusted mass. Cat. No. 349.	2,494
		Polished section. Cat. No. 345.	672
		Polished section. Cat. No. 343.	327
		Fragment from interior. Cat. No. 342.	70
		Favars, Aveyron, France.	
201	Fell 1844 Oct. 21 6:45 A. M.	Stone. Intermediate chondrite. Fragment with crust. Cat. No. 1838.	21
		Fragment with crust and polished surface. Cat. No. 1839.	8
		Felix, Perry Co., Alabama.	
202	Fell 1900 May 15 11:30 A. M.	Stone. Spherulitic carbonaceous chondrite. Mass with crust. Cat. No. 1330.	50
		Mass with crust. Cat. No. 613.	44
		Finmarken, Norway.	
203	Found 1902	Iron-stone. Pallasite. Broad, polished slab. Cat. No. 1310.	2,381
		Full-sized section. Polished. Cat. No. 587.	763
		Thin section. Cat. No. 1311.	285
		Fragments. Cat. No. 1312.	74
		Fisher, Polk Co., Minnesota.	
204	Fell 1894 April 9 4 P. M.	Stone. Veined intermediate chondrite. Mass with crust. Cat. No. 1341.	277
		Mass from interior. Cat. No. 596.	185

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Flows, (Monroe), Cabarrus Co., North Carolina.	
205	Fell 1849 Mar. 31 3 P. M.	Stone. Veined gray chondrite. Mass from interior. Tough and compact. Cat. No. 1761.	80
		Mass with crust and polished surface. Cat. No. 1762.	19
		Fragment from interior. Cat. No. 256.	4
		Forest City, Winnebago Co., Iowa.	
206	Fell 1890 May 2 5.15 P. M.	Stone. Spherical chondrite. Six hundred and seventy-seven complete individuals ranging in weight from 500 grams to 3 grams. They show a great variety of shapes and kinds of crust. Cat. Nos. 326, 341.	10,452
		Complete individual. Cat. No. 340.	4,308
		Complete individual. Cat. No. 1807.	1,774
		Complete individual. Cat. No. 1972.	1,698
		About two-thirds of a complete individual. Cat. No. 1808.	1,188
		Nearly complete individual. Cat. No. 1809.	575
		Complete individual. Cat. No. 1810.	550
		Three complete individuals. Cat. No. 1816.	330
		Complete individual. Cat. No. 1811.	295
		Complete individual. Cat. No. 1812.	274
		Complete individual. Cat. No. 1815.	261
		Complete individual. Cat. No. 1813.	235
		Twenty-one small, complete individuals. Cat. No. 1818.	139
		Eight small individuals. Cat. No. 1819.	13
		Forsyth, Monroe Co., Georgia.	
207	Fell 1829 May 8 3:30 P. M.	Stone. Veined chondrite. Mass with crust. Cat. No. 1788.	42
		Mass with crust. Cat. No. 241.	34
		Fragment from interior. Cat. No. 1789.	6
		Polished chip and fragment. Cat. No. 240.	5
		Forsyth County, North Carolina.	
208	Found 1891	Iron. Ataxite. Full-sized section with crust. Etched. Cat. No. 1014.	550
		Polished slab. Cat. No. 568.	384
		Fort Duncan, Maverick Co., Texas.	
209	Found 1882	Iron. Hexahedrite. Etched section, 8x20 cm., with crust. Cat. No. 852.	434
		Thin slab, with crust, etched. The etched surface is stippled and shows Neumann lines. Small grains of troilite are visible. Cat. No. 113.	104
		Smithsonian iron. Sawed fragment with crust. Cat. No. 853.	12
		Fort Pierre, Stanley Co., South Dakota.	
210	Found 1856	Iron. Medium octahedrite. Etched section with crust. Cat. No. 1068.	64

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Franceville, El Paso Co., Colorado.	
211	Found 1890	Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 863.	892
		Frankfort, Franklin Co., Alabama.	
212	Found 1866	Iron. Medium octahedrite. Etched, interior section. Cat. No. 1073.	5
		Frankfort, Franklin County, Alabama.	
213	Fell 1829 May 8 3 P. M.	Stone. Howardite. Mass from interior, with sawed surface. Cat. No. 1359.	16
		Fragment with crust. Cat. No. 1358.	6
		Fukutomi, Hizen, Japan.	
214	Fell 1882 Mar. 19 1 P. M.	Stone. Veined gray chondrite. End piece with crust and polished surfaces. Polished surfaces dotted with light chondri. Metal scanty. Cat. No. 1491.	179
		Futtehpur, India.	
215	Fell 1822 Nov. 30 6 P. M.	Stone. Veined white chondrite. Mass with crust and sawed surfaces. Cat. No. 1733.	39
		Mass with crust and sawed surfaces. Cat. No. 1734.	38
		Polished fragment with crust. Cat. No. 588.	17
		These specimens are of too firm texture and dark color to be white chondrite. Mass with crust. Cat. No. 773.	7
		Galapian, Lot-et-Garonne, France.	
216	Fell 1826 May 25	Stone. Brecciated white chondrite. Two fragments, one with crust. Cat. No. 1777.	5
		Gargantillo, see Tomatlan.	
		Gerona, Spain.	
217	Found 1900	Stone. Brecciated white chondrite. Fragment from interior showing dark and light-colored areas. Cat. No. 1487.	1
		Ghambat, Sindh, India.	
218	Fell 1897 Sept. 15	Stone. Veined intermediate chondrite. Mass with crust and two polished surfaces. One metallic grain is 5 mm. in diameter. Cat. No. 1512.	72
		Gilgoin, New South Wales.	
219	Recognized 1889	Stone. Crystalline chondrite. Complete individual. The surface is much reddened by oxidation. Cat. No. 1425.	12,020
		Mass with crust. Polished. Cat. No. 1424.	757
		Mass with crust. Polished. Cat. No. 538.	214
		Girgenti, Sicily.	
220	Fell 1853 Feb. 10 1 P. M.	Stone. Veined white chondrite. Mass with crust on two surfaces. Cat. No. 1774.	45
		Mass with crust. Shows abundant veining. Cat. No. 1775.	29
		Polished fragments from interior. Very fine-grained. Cat. No. 263.	1

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Glorieta Mountains, Santa Fe Co., New Mexico.	
221	Found 1884	Iron. Medium octahedrite. Complete individual of dumb-bell shape. It contains blebs of chrysolite 1 cm. in diameter. Cat. No. 997.	1,459
		Full-sized, etched section, 11x13 cm. Cat. No. 122.	1,271
		Cut mass showing etched, torn and striated surfaces. The figures on two surfaces are curved. Cat. No. 999.	1,132
		Complete, pear-shaped individual. Cat. No. 998.	350
		Etched section. The lamellæ are remarkable for their length of 5 cm. Cat. No. 1002.	285
		Broad, thin, etched section showing curved figures. Cat. No. 1001.	67
		Etched section. Cat. No. 123.	13
		Gnadenfrei, Silesia, Germany.	
222	Fell 1879 May 17 4 P. M.	Stone. Spherulitic chondrite. Fragment with crust. Cat. No. 1549.	18
		Fragment with crust. Cat. No. 1550.	6
		Goalpara, Assam, India.	
223	Found 1868	Stone. Ureilite. Fragments. Cat. No. 764.	7
		Fragments, including crust and polished surface. Cat. No. 1771.	6
		Grand Rapids, Kent Co., Michigan.	
224	Found 1883	Iron. Fine octahedrite. Thick, full-sized section, 16x22 cm., polished and etched. Cat. No. 117.	7,881
		Full-sized section, 17x23 cm., etched. Cat. No. 1102.	2,268
		Full-sized, etched section. Cat. No. 1101.	1,386
		Full-sized, etched section, 13x17 cm., etched. Cat. No. 116.	1,160
		Greenbrier County, West Virginia.	
225	Found 1880	Iron. Coarse octahedrite. Polished slab with crust. Octahedral figures can be dimly seen. Cat. No. 957.	18
		Groslee, L'Ain, France.	
226	Found 1827	Iron. Finest octahedrite(?) Fragment. Cat. No. 1088.	2
		Grosnaja, (Mikenskoi), Caucasus, Russia.	
227	Fell 1861 June 28 7 P. M.	Stone. Black chondrite. Slab from interior with polished surfaces. Takes a fair polish. Cat. No. 1732.	76
		Fragments from interior. Cat. No. 485.	4
		Gross-Divina, Trentsiner Com., Hungary.	
228	Fell 1837 July 24 11:30 A. M.	Stone. Spherical chondrite. Fragments with crust. Interior brownish-gray, friable. Crust black. Cat. No. 1792.	5

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Grossliebenthal, Kherson, Russia.	
229	Fell 1881 Nov. 19 6:30 A. M.	Stone. Veined white chondrite. Mass from interior. Cat. No. 785.	24
		Mass with crust. Cat. No. 1830.	21
		Fragments with crust. Cat. No. 549.	1
		Grüneberg, Silesia, Germany.	
230	Fell 1841 Mar. 20 3:30 P. M.	Stone. Veined gray chondrite. Mass with slightly crusted surface. Cat. No. 1478.	99
		Slab with crust and two polished surfaces. Cat. No. 1479.	12
		Two fragments with crust. Cat. No. 1481.	3
		Guareña, Badajoz, Spain.	
231	Fell 1892 July 20 10:30 A. M.	Stone. Crystalline chondrite. Fragment with crust. Cat. No. 1539.	14
		Fragment from interior with polished surface. Cat. No. 1540.	6
		Guffey, Park Co., Colorado.	
232	Found 1907	Iron. Ataxite. Fragment of bright nickel color. Cat. No. 770.	3
		Guilford County, North Carolina.	
233	Found 1822	Iron. Medium octahedrite. Oxidized fragment. Cat. No. 1066.	3
		Gütersloh, Westphalia, Germany.	
234	Fell 1851 April 17 8 P. M.	Stone. Brecciated spherulitic chondrite. Fragments from interior. Cat. No. 1495.	2
		Hainholz, Westphalia, Germany.	
235	Found 1856	Iron-stone. Mesosiderite. Mass with crust and polished surface. Cat. No. 1287.	1,048
		Mass with crust and polished surface. Cat. No. 1288.	768
		Full-sized section, polished. Cat. No. 1290.	402
		End piece, polished. Cat. No. 1289.	369
		Hammond, St. Croix Co., Wisconsin.	
236	Found 1884	Iron. Compact with octahedral streaks. Etched section with crust. Shows large, circular and crescentic inclusions of schreibersite. Cat. No. 987.	98
		Thin slab, showing one etched and one polished surface. The typical figures of this iron are well illustrated. Cat. No. 124.	35
		Haniet el Beguel, Algeria, Africa.	
237	Found 1888	Iron. Medium octahedrite. Full-sized section with polished surface. Cat. No. 944.	11
		Harrison County, Indiana.	
238	Fell 1858 Mar. 28 4 P. M.	Stone. Howarditic chondrite. Fragment from interior. Cat. No. 1494.	1
		Hartford, see Marion.	

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
239	Found 1890	**Hassi Jekna.** Algeria, Africa. Iron. Fine octahedrite. Fragment. Cat. No. 1065.	1
240	Found 1895	**Hayden Creek,** Lemhi Co., Idaho. Iron. Medium octahedrite. Etched section with crust. Shows typical octahedral figures. Cat. No. 489. Etched section with crust. Cat. No. 1020.	51 25
241	Found 1901	**Hendersonville,** Henderson Co., North Carolina. Stone. Chondrite. Fragment with crust. Color rust brown and shows "sweating" tendency. Cat. No. 1773.	23
242	Fell 1857 April 1 Night	**Heredia,** Costa Rica, Central America. Stone. Brecciated spherical chondrite. Fragment with crust. Cat. No. 1781. Fragment from interior. Light grey with metallic grains. Texture rather firm. Cat. No. 442.	5 4
243	Found 1909	**Hermitage Plains,** Australia. Stone. Mass with crust. Cat. No. 784.	218
244	Fell 1869 Jan. 1 12:30 P. M.	**Hessle,** Sweden. Stone. Spherical chondrite. Complete individual. Form tetrahedral. Cat. No. 1750. Complete individual. Minutely pitted. Cat. No. 1751. Sawed fragment with crust. Cat. No. 297. Nearly complete individual. Cat. No. 298. Complete individual. Cat. No. 1752.	363 37 10 5 1
245	Found 1882	**Hex River,** Cape Colony, South Africa. Iron. Hexahedrite. Sawed slab, one surface etched. Neumann lines are partially discernible, but more prominent are the parallel systems of rhabdite characteristic of this iron. These are beautifully shown in this specimen. Cat. No. 115. Polished slab with crust. The rhabdite inclusions are less abundant than in the preceding specimen. Cat. No. 986.	364 248
246	Fell 1804 April 4 Morning	**High Possil,** Scotland. Stone. White chondrite. Fragment with crust Cat. No. 1551.	4
247	Fell 1912 July 19 7 P. M.	**Holbrook,** Navajo County, Arizona. Stone. Crystalline spherulitic chondrite. 196 complete individuals. Cat. No. 801.	11,000
248	Found 1887	**Holland's Store,** Chattanooga Co., Georgia. Iron. Brecciated hexahedrite. Full-sized slab, thin, with polished surface. Cat. No. 1007. Thin fragment with crust. Polished surface. Cat. No. 129.	248 28

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Homestead, (Amana), Iowa Co., Iowa.	
249	Fell 1875 Feb. 12 10:15 P. M.	Stone. Brecciated gray chondrite. About three-fourths of a complete individual. Cat. No. 313.	7,626
		Complete individual. Form pyramidal. Some secondary crust. Cat. No. 1345.	5,443
		Complete individual. Cat. No. 312.	3,175
		Full-sized, polished section, 16x20 cm. Cat. No. 314.	1,744
		Nearly complete individual. Cat. No. 1344.	1,330
		Honolulu, Hawaiian Islands.	
250	Fell 1825 Sept. 27 10:30 A. M.	Stone. Veined white chondrite. Two fragments with crust. Cat. No. 1553.	17
		Hopewell Mounds, Ross Co., Ohio.	
251	Prehistoric Described 1902	Iron. Medium octahedrite. Fragment with etched surface. Cat. No. 480.	125
		Beads made from meteorite. Cat. No. 481.	20
		Hopper, Henry Co., Virginia.	
252	Found 1889	Iron. Medium octahedrite. Cleavage pieces, much oxidized. Cat. No. 136.	47
		Crust fragment. Cat. No. 996.	7
		Hraschina, Croatia, Hungary.	
253	Fell 1751 May 26 6 P. M.	Iron. Medium octahedrite. Etched, interior fragment. Figures distinct. Cat. No. 1072.	9
		Hungen, Hesse, Germany.	
254	Fell 1877 May 17 7 A. M.	Stone. Veined gray chondrite. Three fragments with crust and polished surfaces. Cat. No. 1573.	9
		Hvittis, Finland, Russia.	
255	Fell 1901 Oct. 21 Noon	Stone. Hvittisite. Mass with crust and polished surface. Abundant, minute, metallic grains. Cat. No. 1470.	567
		Polished fragment with crust. Cat. No. 578.	136
		Ibbenbühren, Westphalia, Germany.	
256	Fell 1870 June 17 2 P. M.	Stone. Chladnite. Fragments from interior. Cat. No. 1554.	5
		Iharaota, Lalitpur, India.	
257	Fell 1887 April 17 10:30 A. M.	Stone. Veined howarditic chondrite. Sawed fragment with crust. Cat. No. 1516.	10
		Fragment with crust. Cat. No. 1517.	1
		Ilimäes, Atacama, Chile.	
258	Found 1872	Iron-stone. Pallasite. Full-sized section, 22x31 cm. Polished. Cat. No. 1267.	11,000
		Segment with crust and sawed surface. Cat. No. 742.	393

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Illinois Gulch, Deer Lodge Co., Montana.	
259	Found 1897	Iron. Ataxite. Full-sized, thick section, with polished surfaces. Cat. No. 838.	460
		End piece. Cat. No. 839.	120
		Half-section, etched. Cat. No. 840.	82
		Imilac, Atacama, Chile.	
260	Found 1800	Iron-stone. Pallasite. End piece. Cat. No. 1326.	206
		Etched section. The metallic portion exhibits occasional figures. Cat. No. 162.	205
		Complete individual. Cat. No. 1325.	118
		Polished slab. Cat. No. 1328.	63
		Iron matrix with a little stony filling. Cat. No. 161.	28
		Like previous specimen. Cat. No. 160.	12
		Indarch, Caucasus, Russia.	
261	Fell 1891 April 7	Stone. Carbonaceous spherical chondrite. Nearly complete individual. One surface polished. Cat. No. 1404.	18,060
		Full-sized, polished section. Cat. No. 1403.	1,812
		Mass with crust. Cat. No. 1402.	115
		Mass with crust. Cat. No. 1401.	85
		Interior fragment. Cat. No. 506.	15
		Indian Valley, Floyd Co., Virginia.	
262	Found 1887	Iron. Brecciated hexahedrite. About one-half the original mass. Cat. No. 154.	7,426
		Etched end piece. Cat. No. 981.	1,814
		Full-sized section, polished. Cat. No. 1950.	535
		Indio Rico, Argentine, South America.	
263	Found 1900	Stone. Crystalline chondrite. Fragment with crust. Mass fine-grained, dark brown and shows considerable "sweating," Crust color of interior. Cat. No. 1520.	11
		Iquique, Tarapaca, Chile.	
264	Found 1871	Iron. Ataxite. Etched slab with crust. Cat. No. 1067.	11
		Iredell, Bosque Co., Texas.	
265	Found 1898	Iron. Hexahedrite. Fragment from surface, etched. Cat. No. 1079.	11
		Iron Creek, (Victoria), Saskatchewan, Canada.	
266	Found 1871	Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 1897.	253
		Itapicuru-Mirim, Maranhao, Brazil.	
267	Fell 1879 March	Stone. Spherulitic chondrite. Mass with crust and sawed surface. Characters typical for the class. Cat. No. 1747.	220

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Ivanpah, San Bernardino Co., California.	
268	Found 1880	Iron. Medium octahedrite. Etched slab with crust. Cat. No. 1118.	220
		Chiseled fragment showing no cleavage. Cat. No. 112.	3
		Jackson County, Tennessee.	
269	Found 1846	Iron. Medium octahedrite. Cleaved mass with nearly plane surfaces. One end etched. Cat. No. 1116.	116
		Jamestown, Stutsman Co., North Dakota.	
270	Found 1885	Iron. Fine octahedrite. End piece, etched. Cat. No. 1021.	583
		Etched section, 2.5x11 cm., with crust. Figures dimly outlined. Cat. No. 483.	104
		Jamkheir, Ahmednuggur, India.	
271	Fell 1866 Oct. 5	Stone. Fragment with crust and polished surface. Cat. No. 1572.	1
		Jamyschewa, see Pavlodar.	
		Jelica, Servia.	
272	Fell 1889 Dec. 1 2:30 P. M.	Stone. Amphoterite. Fragment with crust. Crust black, rather smooth, the surface showing typical pittings. Interior gray, with angular pieces of bronzite projecting from a fine-grained groundmass. Texture friable. Metallic grains small and scarce. Cat. No. 511.	69
		Three masses, each with crust. All are good examples of the meteorite. Cat. Nos. 1353–5.	194
		Mass with crust. Cat. No. 605.	26
		Jenny's Creek, Wayne Co., West Virginia.	
273	Found 1883	Iron. Coarse octahedrite. Two masses showing cleavage octahedrons, separated by bright plates of taenite. Cat. No. 954.	115
		Chiseled fragments similar to above. Cat. No. 114.	21
		Jerome, Gove Co., Kansas.	
274	Found 1894	Stone. Crystalline spherulitic chondrite. Mass with crust. All oxidized to uniform, rust-brown color. Cat. No. 1518.	63
		Jewell Hill, Madison Co., North Carolina.	
275	Found 1854	Iron. Fine octahedrite. Etched slab with crust. The narrow bands meet at angles of 90°. Cat. No. 1108.	40
		Jhung, Punjaub, India.	
276	Fell 1873 June	Stone. Spherical chondrite. Two fragments with crust. Cat. No. 1798.	12
		Polished, interior fragment. Cat. No. 1799.	6
		Fragments from interior. Cat. Nos. 305–6.	6

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
277	Found 1858	**Joel's Iron.** Atacama, Chile. Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 940.	44
278	Found 1884	**Joe Wright Mountain,** Independence Co., Arkansas. Iron. Medium octahedrite. Broad, thin, etched slab with crust. Shows circular inclusion of troilite and perforation 1.5 cm. in diameter. Cat. No. 982. Thin slab, etched, showing nodules of troilite and typical figures. The arrangement of plates about one of the troilite nodules suggests a spherulite. Cat. No. 120.	266 98
279	Fell 1819 June 13 6 A. M.	**Jonzac,** Charente Inferieure, France. Stone. Eukrite. Fragment with crust. Cat. No. 1482. Fragment from interior. Cat. No. 1483.	5 2
280	Fell 1876 Feb. 16	**Judesgeri,** Mysore, India. Stone. Spherulitic chondrite. Fragment from interior. Cat. No. 1529.	4
281	Found 1866	**Juncal,** Atacama, Chile. Iron. Medium octahedrite. Etched slab with crust. Cat. No. 140. Etched slab with crust. Cat. No. 1201. The etched figures in both specimens are very distinct.	60 50
282	Fell 1821 June 15 3:30 P. M.	**Juvinas,** Ardêche, France. Stone. Eukrite. Mass with crust. The typical characters of the eukrites are well exhibited. Cat. No. 1365. Mass from interior. Several cavities show crystal plates of anorthite. Cat. No. 1366.	107 78
283	Fell 1857 April 15 10:30 P. M.	**Kaba,** Hungary. Stone. Carbonaceous chondrite. Fragment from interior. Black with light colored spots. Cat. No. 1745.	2
284	Fell 1858 May 19 8 A. M.	**Kakowa,** Hungary. Stone. Veined gray chondrite. Fragments. Cat. No. 1493.	0.2
285	Fell 1840 May 4 Noon	**Karakol,** Kirgjiz Steppe, Asia. Stone. White chondrite. Mass with crust and polished surface. Metal scarce. Cat. No. 1498.	30
286	Known 1887	**Kendall County,** Texas. Iron. Brecciated hexahedrite. Full-sized slab with polished surface. Cat. No. 1023. Full-sized slab with polished surface. Cat. No. 1022. Thin slab with crust, sawed and etched surfaces. Cat. No. 138.	410 286 118

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Kenton County, Kentucky.	
287	Found 1889	Iron. Medium octahedrite. About one-third of the original mass, showing crust and polished surface, 22x42 cm. Contains nodules of troilite. Cat. No. 133.	36,600
		Full-sized slab, 23x44 cm. Both sides polished. Cat. No. 135.	12,231
		Full-sized, etched section, 20x50 cm. Cat. No. 1052.	9,637
		Full-sized, etched section. Cat. No. 1053.	8,494
		Full-sized slab, 14x49 cm., etched. Figures very distinct and regular. Shows marked cleavage and tendency to separate along the cleavage planes. Perfect octahedrons can be cleaved out from the mass. Cat. No. 134.	7,483
		Kerilis, Cotes-du-Nord, France.	
288	Fell 1874 Nov. 26 10:30 A. M.	Stone. Veined gray chondrite. Slab with crust. One surface polished. Metal abundant. Cat. No. 1524.	35
		Fragment with crust. Cat. No. 1525.	4
		Fragment with crust. Cat. No. 758.	3
		Kermichel, Morbihan, France.	
289	Fell 1903 June 30	Stone. Crystalline chondrite. Mass, much oxidized. Cat. No. 796.	63
		Kernouve, (Cléguérec), Morbihan, France.	
290	Fell 1869 May 22 10 P. M.	Stone. Veined crystalline chondrite. Mass from interior. Cat. No. 1484.	106
		Polished fragments. Cat. Nos. 300–1.	26
		Kesen, Hondo, Japan.	
291	Fell 1850 June 13	Stone. Brecciated spherical chondrite. Mass showing crust and interior A portion of the surface is armored. Cat. No. 257.	1,286
		Similar to previous specimen. Cat. No. 258.	1,211
		Mass with crust. Cat. No. 1827.	677
		Mass from interior with polished surface. Cat. No. 1828.	607
		Khairpur, Bhawalpur, India.	
292	Fell 1873 Sept. 23 5 A. M.	Stone. Crystalline chondrite. Slab with polished surface. Metal thickly distributed in fine grains. Cat. No. 1538.	63
		Kharkow, (Jigalowka), Charkow, Russia.	
293	Fell 1787 Oct. 12 3 P. M.	Stone. Veined white chondrite. Fragment with crust. Cat. No. 1535.	10
		Fragment from interior with polished surface. Darker than preceding specimen. Cat. No. 1536.	7
		Khetrie, Rajputana, India.	
294	Fell 1867 Jan. 19 9 A. M.	Stone. Brecciated gray chondrite. Fragment from interior. Cat. No. 1485.	6

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
295	Fell 1809	**Kikino,** Smolensk, Russia. Stone. Veined white chondrite. Mass with crust. The interior is considerably oxidized. Texture too firm for a white chondrite. Cat. No. 1496.	61
296	Fell 1911 June 16 5 P. M.	**Kilbourn,** Columbia Co., Wisconsin. Stone. Gray chondrite. Full-sized, sawed section with crust. Cat. No. 797.	68
297	Fell 1844 April 29 3:30 P. M.	**Killeter,** County Tyrone, Ireland. Stone. Veined white chondrite. Fragment with crust. Shows considerable veining. Cat. No. 1477.	3
298	Found 1891	**Kingston,** Sierra Co., New Mexico. Iron. Medium octahedrite. End piece, etched. Cat. No. 800.	1,161
299	Found 1899	**Kissij,** Kazan, Russia. Stone. Black chondrite. Mass with crust and polished surfaces. Crust and interior of same color. Takes good polish. Cat. No. 1471.	420
300	Fell 1862 Oct. 7 12:30 P. M.	**Klein Menow,** Mecklenberg-Strelitz, Germany. Stone. Crystalline spherical chondrite. Mass with crust and two polished surfaces. Cat. No. 1388. Mass from interior. Cat. No. 1389. Fragment from interior. Cat. No. 278.	701 80 2
301	Fell 1843 Sept. 16 4:45 P. M.	**Klein Wenden,** Saxony, Germany. Stone. Crystalline chondrite. Fragment with crust and polished surface. Dark brown. Crystalline. Takes good polish. Cat. No. 1534.	2
302	Fell 1866 June 9 5 P. M.	**Knyahinya,** Hungary. Stone. Gray chondrite. Mass of flattened form with crust and polished surface. The pittings are small and numerous. Cat. No. 287. Mass with crust and polished surface. Cat. No. 1823. Complete individual. Form flattened. Cat. No. 1821. Complete individual. Form angular. Oriented. Cat. No. 1822. Complete individual. Cat. No. 286. Complete individual. Cat. No. 288. One-half of a complete individual. Polished surface, 13x18 cm. Cat. No. 284. Complete individual. Cat. No. 285.	3,231 2,154 1,525 1,523 239 82 82 10

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Kodaikanal, Madras, India.	
303	Found 1898	Iron. Brecciated octahedrite. Slab, with crust. Cat. No. 574.	175
		Broad, etched slice with crust. Contains silicate inclusions of various shapes and sizes. Cat. No. 943.	128
		Kokomo, Howard Co., Indiana.	
304	Found 1862	Iron. Ataxite. Etched slab with crust. Cat. No. 1061.	40
		Thin, etched slab with crust. Cat. No. 1060.	23
		Kokstad, Cape Colony, Africa.	
305	Found 1887	Iron. Medium octahedrite. Broad, thin, etched slab with crust. Bands short and swollen. Fields nearly wanting. Cat. No. 1015.	270
		Krähenberg, Bavaria, Austria.	
306	Fell 1869 May 5 6:30 P. M.	Stone. Howarditic chondrite. Fragments with crust. Cat. No. 1488.	0.2
		Krasnojarsk, (Medwedewa), Jensiseisk, Russia.	
307	Found 1749	Iron-stone. Pallasite. Torn mass. Cat. No. 1256.	298
		Torn mass. Cat. No. 1255.	190
		Torn mass. Cat. No. 1254.	177
		Metallic mass showing octahedral figures. Cat. No. 505.	169
		Fragments of iron and chrysolite. Cat. No. 159.	76
		Fragments of iron and chrysolite. Cat. No. 158.	12
		Fragment. Cat. No. 157.	7
		Krasnoj-Ugol, Rasan, Russia.	
308	Fell 1829 Sept. 29 2 P. M.	Stone. Spherical chondrite. Fragment from interior. Cat. No. 1564.	0.2
		Kuleschowka, Poltawa, Russia.	
309	Fell 1811 Mar. 12 11 A. M.	Stone. Veined white chondrite. Mass from interior. Cat. No. 1350.	14
		Mass with crust. Cat. No. 1349.	10
		Kyushu, Satsuma, Japan.	
310	Fell 1886 Oct. 26 3 P. M.	Stone. Veined white chondrite. This includes the falls previously listed as Maeme and Oskima.	
		Maeme. Mass with primary and secondary crust. Cat. No. 1783.	158
		Complete individual. Cat. No. 1784.	85
		Fragment with crust. Cat. No. 440.	8
		Oshima. Mass with crust and sawed surface. Cat. No. 1785.	106
		La Becasse, Indre, France.	
311	Fell 1879 Jan. 31	Stone. White chondrite. Sawed mass with crust. Cat. No. 741.	62
		Slab with crust and sawed surfaces. Cat. No. 1364.	28

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
312	Fell 1871 June 14 8 P. M.	**Laborel,** Drome, France. Stone. Brecciated intermediate chondrite. Two fragments with crust. Cat. No. 1670.	16
313	Recognized 1828	**La Caille,** Var, France. Iron. Medium octahedrite. Poorly etched slab with crust. Cat. No. 900.	66
		Etched mass with crust. Cat. No. 901.	35
		Etched slab with crust. Cat. No. 902.	8
314	Found 1860	**La Grange,** Oldham Co., Kentucky. Iron. Fine octahedrite. Etched section with crust. Cat. No. 1194.	172
		Etched section with crust. Cat. No. 84.	47
315	Fell 1803 April 26 1 P. M.	**L'Aigle,** Orne, France. Stone. Brecciated intermediate chondrite. Portions of two individuals with crust. Cat. No. 1407.	405
		Portions of three individuals with crust. Cat. No. 1406.	230
		Mass with crust. Cat. No. 219.	111
		Interior fragment. Cat. No. 1405.	18
316	Found 1905	**Lampa,** Atacama, Chile. Stone. Chondrite. Mass with crust and polished surface. Cat. No. 1408.	886
		Mass with crust and polished surface. Gift of Prof. H. A. Ward. Cat. No. 769.	555
317	Fell 1872 July 23 5:30 P. M.	**Lancé,** Loir-et-Cher, France. Stone. Spherulitic carbonaceous chondrite. Mass with crust and sawed surface. Cat. No. 1351.	97
		Mass with crust. Cat. No. 589.	85
318	Fell 1897 June 20 8:30 P. M.	**Lançon,** Bouches-du-Rhone, France. Stone. Brecciated gray chondrite. Mass with crust and sawed surfaces. Cat. No. 1803.	101
		Mass with crust. Cat. No. 526.	85
319	Found 1888	**La Primitiva,** Tarapaca, Chile. Iron. Ataxite. Thin slab, polished. The characteristic hieroglyphic schreibersites of this meteorite are well shown. Cat. No. 1071.	30
320	Found 1857	**Laurens,** Laurens Co., South Carolina. Iron. Finest octahedrite. Thin, broad, full-sized section, etched. The beautiful figures of this iron are well shown. Cat. No. 959.	40
		Similar to above. Cat. No. 960.	41
321	Fell 1907 Jan. 12 8 P. M.	**Leighton,** Colbert Co., Alabama. Stone. Brecciated gray chondrite. Nearly complete individual with polished surface. The mottled color of the interior is a feature. Cat. No. 768.	640

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Lenarto, Saros, Hungary.	
322	Found 1814	Iron. Medium octahedrite. Etched slab with crust. Usual octahedral figures. Cat. No. 1177.	336
		Etched slab with crust and well-marked figures. Bands long and straight. Cat. No. 1178.	275
		Small slab with torn edges. Etched. Cat. No. 1179.	70
		Lenorka, Poltawa, Russia.	
323	Fell 1902	The locality name given here is taken from Ward's 1904 Catalogue. Berwerth (Fortschritte in der Meteoritenkunde, 1912, p. 235), gives Leonowka, Tschernigow, time of fall unknown. Stone. White chondrite. Fragment with crust. Cat. No. 1413.	1
		Le Pressoir, (Louans), Indre et Loire, France.	
324	Fell 1845 Jan. 25 3 P. M.	Stone. Spherical chondrite (Brezina). The stone is too compact and fine-grained to be a spherical chondrite. Mass with crust and polished surface. Cat. No. 1664.	50
		Fragment with crust. Crust black, smooth. Interior light-grey, somewhat rusted. Outlines of chondri barely discernible. Cat. No. 439.	17
		Les Ormes, Yonne, France.	
325	Fell 1857 Oct. 1	Stone. White chondrite. Fragments with crust. Cat. No. 1417.	1
		Lesves, Namur, Belgium.	
326	Fell 1896 April 13 7:30 A. M.	Stone. Gray chondrite. Mass with crust. The crust is brown-black. Cat. No. 1661.	32
		Fragment with crust. Cat. No. 542.	10
		Le Teilleul, (Le Vivionnere), Manche, France.	
327	Fell 1845 July 14 3 P. M.	Stone. Howardite. Three fragments with crust. Cat. No. 1418.	14
		Lexington County, South Carolina.	
328	Found 1880	Iron. Coarse octahedrite. End piece, etched. The bands are crooked and vary in width. Cat. No. 1114.	907
		Etched slab with crust. The figures are not well defined. Cat. No. 1115.	107
		Etched slab with crust. Cat. No. 111.	23
		Lick Creek, Davidson Co., North Carolina.	
329	Found 1879	Iron. Hexahedrite. Etched slab. Cat. No. 1074.	15
		Limestone Creek, Monroe Co., Alabama.	
330	Found 1834	Iron. Ataxite. Full-sized, etched section. Cat. No. 937.	94
		Polished section with crust. Cat. No. 938.	25

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Limerick, Adare, Ireland.	
331	Fell 1813 Sept. 10 6 A. M.	Stone. Veined gray chondrite. Nearly complete individual. The broken surface is oxidized. This individual is not mentioned by Wülfing. Cat. No. 1795.	52
		Polished chip. Cat. No. 233.	1
		Linville, Burke Co., North Carolina.	
332	Found 1882	Iron. Ataxite. Thin slab, etched. Cat. No. 1110.	28
		Linum, Prussia, Germany.	
333	Fell 1854 Sept. 5	Stone. White chondrite. Fragment with crust. Cat. No. 1414.	0.5
		Lissa, Bunzlau, Bohemia.	
334	Fell 1808 Sept. 3 3:30 P. M.	Stone. Veined white chondrite. Mass with crust. Cat. No. 1410.	150
		Interior fragment. Cat. No. 510.	32
		Mass with crust. Cat. No. 1411.	26
		Little Piney, Pulaski Co., Missouri.	
335	Fell 1839 Feb. 13 3:30 P. M.	Stone. Spherulitic chondrite. Two fragments from interior. Cat. No. 1423.	4
		Lixna, (Lasdany), Kurland, Russia.	
336	Fell 1820 July 12 5:30 P. M.	Stone. Veined gray chondrite. Mass with crust and armored surfaces. Cat. No. 1764.	61
		Slice from interior with polished surface. Cat. No. 1765.	11
		Interior fragment. Cat. No. 550.	2
		Llano del Inca, Atacama, Chile.	
337	Found 1888	Iron-stone. Mesosiderite. Thick, polished slab showing no metal. Cat. No. 190.	148
		Polished mass. Cat. No. 1297.	79
		Complete individual. Cat. No. 189.	54
		Mass with crust. Shows a little metal. Cat. No. 188.	38
		End piece, polished. Cat. No. 1298.	35
		Polished mass. Cat. No. 1299.	27
		Complete individual. Cat. No. 1301.	20
		Polished mass. Cat. No. 1300.	16
		Locust Grove, Henry Co., Georgia.	
338	Found 1857	Iron. Ataxite. Thick, etched slab with crust. Rhabdite inclusions are noticeable. Cat. No. 558.	370
		Full-sized section, etched. Cat. No. 1192.	227
		Lodhran, Punjaub, India.	
339	Fell 1868 Oct. 1	Iron-stone. Lodhranite. Three fragments. Cat. No. 1260.	2
		Lonaconing, Allegheny Co., Maryland.	
340	Found 1888	Iron. Coarse octahedrite. Full-sized, etched section. Bands long, broad and straight. Cat. No. 941.	39

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Long Island, Phillips Co., Kansas.	
341	Found 1892	Stone. Crystalline chondrite. Four large masses with crust which, joined together, form the front of a well oriented individual. Cat. No. 350.	303,000
		About 3,000 smaller pieces belonging to the same individual. Cat. No. 350.	225,488
		Mass with crust. Cat. No. 1889.	9,298
		Mass with crust and polished surface. Cat. No. 1890.	2,265
		Polished mass from interior. Cat. No. 1891.	2,154
		Mass with crust. Cat. No. 1893.	800
		Mass with crust. Cat. No. 1894.	270
		Los Reyes, Mexico, F. D. Mexico.	
342	Found 1897	Iron. Medium octahedrite. This meteorite was referred by the writer in 1902 (Pub. Field Col. Mus., Geol. Ser. Vol. I, p. 305) to Toluca, but owing to the distance of its place of find from Toluca he now regards it as a distinct fall. Complete individual. Cat. No. 454.	19,500
		Losttown Creek, Cherokee Co., Georgia.	
343	Found 1868	Iron. Medium octahedrite. Polished mass with crust. Cat. No. 1058.	76
		Lucé, Sarthe, France.	
344	Fell 1768 Sept 13 4:30 P. M.	Stone. White chondrite. Two fragments from interior. Cat. No. 1421.	5
		Lucky Hill, Jamaica.	
345	Found 1885	Iron. Medium octahedrite. Six oxidized fragments. Cat. No. 1151.	51
		Luis Lopez, Socorro Co., New Mexico.	
346	Found 1896	Iron. Medium octahedrite. About one-half the original mass with etched surface 11x19 cm. Cat. No. 913.	3,061
		Lujan, Argentine.	
347	Prehistoric	Iron-stone. Mesosiderite. Two crust fragments. Cat. No. 1400.	3
		Lumpkin, Stewart Co., Georgia.	
348	Fell 1869 Oct. 6 11:45 A. M.	Stone. Crystalline spherulitic chondrite. Slice with crust and polished surfaces. Cat. No. 1412.	3
		Lundsgard, Sweden.	
349	Fell 1889 April 3 8:30 P. M.	Stone. White chondrite. Mass with crust. Cat. No. 1398.	34
		Mass with crust. Cat. No. 1399.	21
		Luotolaks, Finland.	
350	Fell 1813 Dec. 13 Day	Stone. Howardite. Fragments from interior. Cat. No. 1613.	3

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Luponnas, Aine, France.	
351	Fell 1753 Sept. 7 1 P. M.	Stone. Brecciated intermediate chondrite. Mass with crust. Cat. No. 1419.	15
		Macao, Rio Grande do Norte, Brazil.	
352	Fell 1836 Nov. 11 5 A. M.	Stone. Veined intermediate chondrite. Three fragments with crust. Each fragment weighs about 25 grams. Cat. No. 1640.	68
		Slab with crust and polished surfaces. Cat. No. 1641.	12
		Fragment with crust. Cat. No. 787.	4
		Madoc, Hastings Co., Ontario, Canada.	
353	Found 1854	Iron. Fine octahedrite. Slab with crust and etched surface. The figures are irregular and indistinct. Cat. No. 1189.	24
		Spheroidal fragment showing natural surface with pittings. Cat. No. 65.	9
		Thin, sawed slab with natural surface. Cat. No. 66.	5
		Madrid, Spain.	
354	Fell 1896 Feb. 10 9:30 A. M.	Stone. Veined white chondrite. Fragments from interior. Cat. No. 1422.	1
		Magura, Arva, Hungary.	
355	Found 1840	Iron. Coarse octahedrite. Rough mass. Cat. No. 887.	845
		Etched mass. Figures dimly indicated. Cat. No. 888.	520
		Etched mass. No figures are apparent. Cat. No. 47.	166
		Rough mass, showing cleavage. Cat. No. 46.	137
		Mainz, Hesse, Germany.	
356	Found 1852	Stone. Veined intermediate chondrite. Two fragments from interior with polished surfaces The stone takes a good polish. Cat. No. 1649.	26
		Fragment from interior with polished surfaces. Cat. No. 1650.	13
		Polished fragment. Cat. No. 441.	2
		Makariwa, New Zealand.	
357	Found 1879	Stone. Brecciated gray chondrite. Polished fragment with crust. Cat. No. 1590.	3
		Manbhoom, Bengal, India	
358	Fell 1863 Dec. 22 9 A. M.	Stone. Amphoterite. Mass from interior. Cat. No. 1621.	20
		Mass with crust. Cat. No. 1620.	18
		Fragments from interior. Cat. No. 583.	11
		Manegaum, Kandeish, India.	
359	Fell 1843 June 29 3:30 P. M.	Stone. Chladnite. Fragment from interior. Cat. No. 1632.	1

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
360	Found 1876	**Mantos Blancos,** Atacama, Chile. Iron. Fine octahedrite. Thin slab, etched. Cat. No. 1062.	72
361	Fell 1847 Feb. 25 2:45 P. M.	**Marion,** Linn Co., Iowa. Stone. Veined white chondrite. Mass with crust. The crust, thick and dull black, is intersected by numerous cracks. Cat. No. 255.	128
		Mass with crust and polished surfaces. The stone takes a good polish. Cat. No. 1749.	60
362	Fell 1902 Jan. 6 10 P. M.	**Marjalahti,** Finland. Iron-stone. Pallasite. Mass with crust. Cat. No. 1324.	738
		Mass with crust. Cat. No. 1323.	544
		Section 5x10 cm. polished and etched. Cat. No. 562.	137
363	Fell 1848 July 4	**Marmande,** Lot-et-Garonne, France. Stone. Spherulitic chondrite. Fragment from interior. Friable. Cat. No. 1595.	2
364	Found 1860	**Marshall County,** Kentucky. Iron. Medium octahedrite. Etched fragment with crust. Cat. No. 945.	18
365	Found 1898	**Mart,** McLennan Co., Texas. Iron. Finest octahedrite. End piece, etched. Cat. No. 1040.	1,132
366	Fell 1835 Jan. 31 12–1 P. M.	**Mascombes,** Corréze, France. Stone. White chondrite. Fragment from interior with polished surface. Cat. No. 1592.	8
		Fragment with crust. Cat. No. 1591.	7
367	Fell 1803 Dec. 13 10:30 A. M.	**Mässing,** Bavaria, Austria. Stone. Howardite. Two fragments from interior. Cat. No. 1648.	2
368	Found 1885	**Matatiela,** Cape Colony, Africa. Iron. Medium octahedrite. Slab with crust and etched surface. The crust surface has only a slight, black coating. The bands of the etching figures are long and straight. Cat. No. 936.	24
369	Fell 1768 Nov. 20 4 P. M.	**Mauerkirchen,** Austria. Stone. White chondrite. Mass with crust. Two polished surfaces show scattered metallic grains and well-marked chondri. Cat. No. 211.	110
		Mass from interior with polished surface. Cat. No. 1610	16
		Fragment with crust. Cat. No. 1611.	17
		Fragment with crust. Cat. No. 1612.	15

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Mauritius, Indian Ocean.	
370	Fell 1801 Dec. 22	Stone. Howarditic chondrite. Fragment with crust. Cat. No. 1606.	6
		McKinney, Collin Co., Texas.	
371	Found 1870	Stone. Black chondrite. Complete individual with one polished face, 33x35 cm. Thickness of stone 25 cm. The bounding surfaces are generally concave. See Plate LXIII. Cat. No. 1438.	52,163
		Mass with crust and polished surface. Cat. No. 1436.	2,610
		Full-sized, polished section. Cat. No. 1437.	2,491
		Mass with crust and polished surface. Cat. No. 355.	72
		Mejillones, Atacama, Chile.	
372	Found 1875	Iron. Brecciated hexahedrite. Etched fragment. Granular structure visible. Cat. No. 1063.	2
		Mejillones, Atacama, Chile.	
373	Described 1875	Iron-stone. Grahamite. Polished section with crust. Large inclusions of chrysolite are noticeable. Cat. No. 1266.	185
		Merceditas, Chile.	
374	Found 1884	Iron. Medium octahedrite. Etched slab with crust. The bands are remarkably long and straight. Cat. No. 992.	729
		Similar to previous specimen. Cat. No. 821.	173
		Etched slab with crust. Cat. No. 586.	156
		Mern, Denmark.	
375	Fell 1878 Aug. 29 2:30 P. M.	Stone. Veined crystalline spherical chondrite. Mass with crust. Shows large grains of troilite. Cat. No. 1589.	29
		Meuselbach, Germany.	
376	Fell 1897 May 19 7:45 P. M.	Stone. Veined crystalline spherulitic chondrite. Fragment with crust. Cat. No. 1855.	3
		Mexico, (Pampanga), Luzon, Philippines.	
377	Fell 1859 April 4	Stone. Brecciated gray chondrite. Fragment with polished surface. Shows vein of metal. Cat. No. 1598.	2
		Mezö-Madaras, Transylvania, Hungary.	
378	Fell 1852 Sept. 4 4:30 P. M.	Stone. Brecciated gray chondrite. Mass with crust and armored surfaces. Cat. No. 1608.	331
		Mass with crust and polished surfaces. Cat. No. 1607.	166
		Fragment with crust. Cat. No. 261.	4
		Interior fragment. Polished. Cat. No. 260.	2
		Mhow, N. W. Provinces, India.	
379	Fell 1827 Feb. 16 3 P. M.	Stone. Intermediate chondrite. Fragment from interior. Polished surface. Cat. No. 1633.	2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
380	Fell 1851 Mar. 14 3:30 P. M.	**Middleborough,** York, England.	
		Stone. White chondrite. Fragments with crust. Cat. No. 1634.	0.1
381	Fell 1889 June 9 8:30 A. M.	**Mighëi,** Kherson, Russia.	
		Stone. Carbonaceous chondrite. Large mass with crust. Cat. No. 1456.	2,250
		Fragments with crust. Cat. Nos. 338–9.	5
382	Fell 1842 April 26 3 P. M.	**Milena,** (Pusinsko Selo), Croatia, Hungary.	
		Stone. White chondrite. Polished slab with crust. Cat. No. 1849.	10
		Fragment from interior. Cat. No. 250.	6
		Fragment from interior. Cat. No. 1850.	3
383	Fell 1888	**Minas Geraes,** Brazil.	
		Stone. Veined white chondrite. Mass with crust and polished surface. A vein and armored surface are shown. The stone takes a good polish. Cat. No. 1622.	422
384	Found 1857	**Mincy,** Taney Co., Missouri.	
		Iron-stone. Mesosiderite. Thin slab, 17x33 cm. with polished surface. Cat. No. 1253.	2,222
		Sawed slab, 10x13 cm., showing natural and polished surfaces. The metallic and non-metallic minerals are about equally abundant. Cat. No. 167.	395
		Fragment with natural surface. Cat. No. 77.	4
385	Fell 1890 April 10 3:30 P. M.	**Misshof,** Kurland, Russia.	
		Stone. Spherulitic chondrite. Mass with crust and polished surface. Cat. No. 1631.	176
		Mass with crust and polished surface. Cat. No. 1630.	97
386	Known 1804	**Misteca,** Oaxaca, Mexico.	
		Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 32.	86
		Etched section. Cat. No. 956.	70
387	Fell 1882 Feb. 3 4 P. M.	**Mocs,** Transylvania, Austria.	
		Stone. Veined white chondrite. Complete individual. Cat. No. 1444.	2,265
		Nineteen individuals. Cat. No. 1447.	1,502
		Complete individual. Cat. No. 1445.	905
		Complete individual. Cat. No. 1446.	564
		Wedge-shaped individual with primary and secondary crust. Cat. No. 1452.	564
		Nearly complete individual. Cat. No. 324.	545
		Mass with crust. Cat. No. 1453.	530
		Polished mass. Cat. No. 1454.	481
		Nearly complete individual. Cat. No. 1451.	338
		Complete individual. Cat. No. 1449.	230
		Oriented fragment. Cat. No. 1450.	188
		Three fragments with crust. Cat. No. 323.	55
		Two individuals. Cat. Nos. 330, 331.	46
		Nine small individuals. Cat. No. 1448.	16

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Moctezuma, Sonora, Mexico.	
388	Found 1899	Iron. Medium octahedrite. Etched slab with fracture edges. Cat. No. 926.	357
		Modoc, Scott Co., Kansas.	
389	Fell 1905 Sept. 2 9:30 P. M.	Stone. White chondrite. Complete individual showing unusual crust markings. Cat. No. 743.	3,181
		Mass with oriented crust. Cat. No. 747.	879
		Nearly complete individual. Cat. No. 745.	283
		Mass with crust. Cat. No. 1971.	180
		Complete individual. Cat. No. 744.	170
		Molina, Murcia, Spain.	
390	Fell 1858 Dec. 24	Stone. Brecciated gray chondrite. Mass with crust. Specimen of uniform brown color from oxidation. Cat. No. 1635.	33
		Molong, Ashburnham Co., New South Wales.	
391	Found 1912	Iron-stone. Pallasite. Section. Cat. No. 1970.	630
		Monte Milone, Rome, Italy.	
392	Fell 1846 May 8 9:30 A. M.	Stone. Brecciated white chondrite. Fragments from interior and with crust. Cat. No. 1623.	13
		Montlivault, Loir-et-Cher, France.	
393	Fell 1838 July 22 Day	Stone. White chondrite. Two fragments with crust and polished surface. Cat. No. 1619.	5
		Mooradabad, N. W. Provinces, India.	
394	Fell 1808	Stone. White chondrite. Fragments from interior. Cat. No. 1596.	1
		Mooranoppin, Lansdowne Co., West Australia.	
395	Recognized 1893	Iron. Coarsest octahedrite. Polished and etched section with crust. Figures irregular. Cat. No. 540.	99
		Full-sized section, etched. Cat. No. 975.	74
		Mooresfort, Tipperary, Ireland.	
396	Fell 1810 August Noon	Stone. Veined gray chondrite. Two fragments from interior. Cat. No. 1681.	16
		Two fragments from interior. Cat. No. 1682.	14
		Fragment with crust. Cat. No. 228.	7
		Mordvinovka, Ekaterinoslaw, Russia.	
397	Fell 1826 May 19	Stone. White chondrite. Mass with crust and polished surface. Metallic grains coarse. Cat. No. 1686.	22
		Fragment from interior. Cat. No. 448.	15
		Fragment from interior. Cat. No. 1687.	11
		Morito, (San Gregorio), Chihuahua, Mexico.	
398	Found 1600	Iron. Medium octahedrite. Etched fragment with crust. Cat. No. 942.	14

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
399	Fell 1875 Sept.	**Mornans,** Drome, France. Stone. Veined gray chondrite. Sawed fragment with crust. Cat. No. 1599.	2
400	Found 1892	**Morradal,** Skiaker, Norway. Iron. Ataxite. Thin, etched slab. Cat. No. 824. Thin, etched slab. Cat. No. 961.	17 5
401	Found 1887	**Morristown,** Hamblen Co., Tennessee. Iron-stone. Mesosiderite. Wedge-shaped section with crust and polished surface. Cat. No. 1282. End piece with polished surface. Cat. No. 1281. Thick, full-sized, polished section. Cat. No. 1280.	2,265 1,247 679
402	Fell 1868 Dec. 22	**Motecka-Nugla,** Bhurtpore, India. Stone. Crystalline chondrite. Fragment with crust and two polished surfaces. Fine-grained. Cat. No. 1683. Fragment from interior. Cat. No. 1684.	7 5
403	Fell 1868 Feb. 29 11 A. M.	**Motta di Conti,** Piedmont, Italy. Stone. Spherulitic chondrite. Mass with crust. Friable. Cat. No. 1685.	37
404	Fell 1902 July 17 9:30 A. M.	**Mount Browne,** Evelyn Co., New South Wales. Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1329. Mass with crust. Cat. No. 576.	226 186
405	Found 1903	**Mount Dyrring,** Singleton, New South Wales. Iron-stone. Pallasite. Mass with crust. Cat. No. 575. Mass with crust. Cat. No. 1320.	292 132
406	Found 1913	**Mount Edith,** Ashburton District, West Australia. Iron. Medium octahedrite. Full-sized, etched section, 58x23 cm. Cat. No. 1959.	10,375
407	Found 1887	**Mount Joy,** Adams Co., Pennsylvania. Iron. Coarsest octahedrite. Full-sized, etched section, 61x83 cm. Cat. No. 1051. Full-sized, etched section, 48x69 cm. Cat. No. 1050. Etched section, 10x13 cm. Cat. No. 432.	20,000 14,814 733
408	Found 1892	**Mount Stirling,** West Australia. Iron. Coarse octahedrite. Full-sized, etched section. Shows abundant cohenite, troilite nodules and one perforation. Cat. No. 1004. Etched fragment. Cat. No. 829.	952 57

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Mount Vernon, Christian Co., Kentucky.	
409	Found 1868	Iron-stone. Pallasite. Polished slab 15x15 cm. Shows net-work of nickel-iron holding rounded or angular masses of chrysolite. The nickel-iron is unequally distributed, occurring now in a solid mass, now in a network. It frequently contains inclusions of schreibersite. Cat. No. 567.	1,000
		Mount Zomba, Nyassa Land, Africa.	
410	Fell 1899 Jan. 25	Stone. Veined white chondrite. Fragment with crust. Cat. No. 1360.	18
		Muddoor, Madras, India.	
411	Fell 1865 Sept. 21 7 A. M.	Stone. Spherulitic chondrite. Fragment with crust. Cat. No. 1593.	6
		Fragment from interior. Cat. No. 1594.	4
		Mungindi, Queensland, Australia.	
412	Found 1897	Iron. Finest octahedrite. Mass 18x8 cm. with etched and pitted surface. Cat. No. 1003.	1,360
		Full-sized, etched section, 21x9 cm. Figures well marked. Numerous troilite inclusions. Cat. No. 461.	627
		Murfreesboro, Rutherford Co., Tennessee.	
413	Found 1847	Iron. Medium octahedrite. Polished mass with oxidized edges. Cat. No. 910.	25
		Etched slab showing distinct figures, the plates of which run principally at right angles. Cat. No. 58.	20
		Thin, etched slab with crust. Cat. No. 909.	20
		Etched slab from surface. Cat. No. 827.	20
		Murphy, Cherokee Co., North Carolina.	
414	Found 1899	Iron. Hexahedrite. Full-sized slab, etched. No. 967.	305
		Full-sized slab, etched. Cat. No. 966.	260
		Polished and etched section. Shows typical sheen of hexahedrites; also a few, small troilite inclusions. Cat. No. 503.	125
		Nageria, N. W. Provinces, India.	
415	Fell 1875 April 24	Stone. Eukrite(?) Fragment with crust. The crust is thick and glassy and the interior shows feldspar and pyroxene. Cat. No. 1674.	2
		Nagy-Borove, Liptoer, Hungary.	
416	Fell 1895 May 9	Stone. Gray chondrite. Complete individual. Cat. No. 1604.	184
		Mass with crust and sawed surfaces. Cat. No. 1605.	26
		Nagy-Vazsony, Hungary.	
417	Found 1890	Iron. Medium octahedrite. Thin slab showing crust, etched and polished surfaces. Cat. No. 139.	37
		Thin slab like preceding. Cat. No. 974.	36

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
418	Fell 1911 June 28 9 A. M.	**Nakhla,** Egypt. Stone. Nakhlite. Fragment with crust. Crust shining and black, interior dark green and crystalline. Cat. No. 804.	15
419	Fell 1886 Jan. 27	**Nammianthal,** Madras, India. Stone. Veined spherulitic chondrite. Mass with crust and sawed surfaces. Cat. No. 1627.	65
		Mass from interior. Cat. No. 1629.	36
		Mass with crust and polished surface. Cat. No. 1628.	20
420	Fell 1825 Feb. 10 Noon	**Nanjemoy,** Charles Co., Maryland. Stone. Spherical chondrite. Mass with crust and sawed surface. Apparently of coarser structure than following specimen. Cat. No. 1626.	82
		Mass with crust and polished surface. Light-gray, fine-grained, somewhat friable. Metallic particles thickly distributed. Cat. No. 1625.	24
421	Found 1855	**Narraburra,** New South Wales. Iron. Finest octahedrite. Full-sized section, deeply etched. Cat. No. 1142.	168
422	Fell 1890 June 6	**Nawapali,** Central Provinces, India. Stone. Carbonaceous chondrite. Fragment from interior. Black. Shows chondri under lens. Not friable. Cat. No. 1655.	2
423	Fell 1870 Jan. 23	**Nedagolla,** Madras, India. Iron. Ataxite. Two fragments, etched. Cat. No. 1090.	10
424	Found 1864	**Nejed,** Wadee Banee Khaled, Central Arabia. Iron. Medium octahedrite. Nearly complete individual with one etched surface. Cat. No. 1100.	48,080
		Etched slab with crust. Cat. No. 523.	180
		Thin, etched slab. Cat. No. 1186.	30
425	Found 1856.	**Nelson County,** Kentucky. Iron. Coarsest octahedrite. Large, polished slab, upon which coarse figures are here and there dimly outlined. Cat. No. 488.	455
		Etched section with crust. Cat. No. 1184.	280
		Polished slab. Cat. No. 1183.	151
		Oxidized scaling. Cat. No. 73.	23
426	Found 1872	**Nenntmannsdorf,** Saxony, Germany. Iron. Hexahedrite. Thin slab with polished surface. Cat. No. 1123.	22
		Cleavage pieces. Cat. No. 447.	4

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Nerft, Kurland, Russia.	
427	Fell 1864 April 12 4:45 A. M.	Stone. Veined intermediate chondrite. Mass with crust. Cat. No. 1637.	62
		Mass from interior. Cat. No. 585.	44
		Ness County, Kansas.	
428	Found 1897	Stone. Crystalline chondrite. Complete individual. Rounded, wedge-shaped. Shows primary and secondary crust. Cat. No. 809.	3,400
		Complete individual. Crust black. Cat. No. 808.	2,947
		Complete individual. Form triangular-pyramidal. Cat. No. 810.	2,265
		Two complete individuals. Cat. No. 813.	1,585
		Complete individual. Cat. No. 754.	1,360
		Complete individual. Cat. No. 593.	1,150
		Complete individual. Form rectangular-prismatic. Cat. No. 811.	1,132
		Complete individual. Cat. No. 812.	906
		End piece with polished surface. Cat. No. 815.	906
		Two complete individuals. Cat. No. 814.	580
		Complete individual. Cat. No. 807.	572
		Thirteen complete individuals. Crust black. Cat. No. 806.	400
		Complete individual. Crust black. Cat. No. 816.	35
		Complete individual. Cat. No. 1973.	22
		Kansada. Mass with crust and polished surfaces. Cat. No. 818.	2,530
		New Concord, Muskingum Co., Ohio.	
429	Fell 1860 May 1 12:45 P. M.	Stone. Veined intermediate chondrite. Individual cut in two parts. Cat. No. 1824.	3,708
		Mass with crust and polished surfaces. A metallic vein is noticeable. Cat. No. 274.	753
		Mass with crust and polished surfaces. Cat. No. 1825.	650
		Mass with crust. Not oxidized. Cat. No. 1826.	440
		Nearly complete individual. Cat. No. 273.	347
		Ngawi, Java.	
430	Fell 1883 Oct. 3	Stone. Ngawite. Sawed section with crust. Cat. No. 1675.	10
		N'Goureyma, Soudan, Africa.	
431	Fell 1900 June 15	Iron. Brecciated octahedrite. Full-sized, etched section. Cat. No. 978.	882
		Full-sized, polished section. Cat. No. 597.	145
		Niagara, Grand Forks Co., North Dakota.	
432	Found 1879	Iron. Coarse octahedrite. Fragment with crust and etched surface. Cat. No. 946.	24
		Nobleboro, Lincoln Co., Maine.	
433	Fell 1823 Aug. 7 4:30 P. M.	Stone. Howardite. Mass with crust. A splendid specimen of this rare meteorite. Cat. No. 1370.	19

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
434	Found 1876	**Nochtuisk,** Yakutsk, Russia. Iron. Coarse octahedrite. Apparently a small individual with one end etched. The substance is porous. Cat. No. 1175.	2
435	Found 1895	**Nocoleche,** New South Wales. Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 1039.	1,120
436	Fell 1879 July 1 Evening	**Nogoya,** Entre Rios, Argentina. Stone. Carbonaceous chondrite. Mass, entirely black in color, one surface having a scoriaceous appearance, the remainder the luster of graphite. Cat. No. 320. Mass with crust. Cat. No. 1680.	10 10
437	Fell 1886 Sept. 22 7:45 A. M.	**Nowo-Urei,** Kazan, Russia. Stone. Ureilite. Mass with crust and polished surface. Color nearly black. Cat. No. 1678. Fragment with crust. Cat. No. 582.	49 5
438	Fell 1851 Nov. 5 5:30 P. M.	**Nulles,** Tarragona, Spain. Stone. Brecciated gray chondrite. Fragments with crust. Cat. No. 1676.	8
439	Found 1895	**Oakley,** Logan Co., Kansas. Stone. Crystalline chondrite. End piece, 25x30 cm. Cat. No. 1458. Full-sized section 25x30 cm. Polished on one surface. Cat. No. 1457. Polished section 5x14 cm. with crust. Gift of Prof. H. A. Ward. Cat. No. 501.	6,579 2,263 263
440	Found 1863	**Obernkirchen,** Prussia, Germany. Iron. Fine octahedrite. Cuboidal mass with crust and polished surfaces. Cat. No. 1081. Etched slab with crust. Cat. No. 1082.	124 61
441	Prehistoric	**Octibbeha,** Octibbeha Co., Mississippi. Iron. Ataxite. Slice. Cat. No. 1174.	1
442	Found 1871	**Oczeretna,** Kief, Russia. Stone. Veined gray chondrite. Fragment with crust and sawed surface. Metal abundant. Cat. No. 1677.	3
443	Fell 1855 May 11 3:30 P. M.	**Oesel,** (Kaande), Livonia, Russia. Stone. White chondrite. Mass from interior. Cat. No. 1688. Crusted fragments. Cat. No. 264.	47 2
444	Found 1730	**Ogi,** Hizen, Japan. Stone. White chondrite. Mass with crust and sawed surface. Cat. No. 1690.	23
445	Fell 1857 Mar. 11 12:15 A. M.	**Ohaba,** Transylvania, Austria. Stone. Veined gray chondrite. Slab with crust and polished surface. Cat. No. 1652.	6

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Okniny, Volhynia, Russia.	
446	Fell 1833 Dec. 22 9:30 A. M.	Stone. Brecciated gray chondrite. Polished slab with crust and armored surface. Cat. No. 1653.	10
		Orange River, Garib, South Africa.	
447	Known 1856	Iron. Medium octahedrite. Sawed section with natural crust, smooth and deeply pitted. Cat. No. 71.	114
		Etched slab, showing typical octahedral figures and nodule of troilite. Cat. No. 72.	95
		Etched slab with crust. Cat. No. 1896.	74
		Orgueil, Tarn et Garonne, France.	
448	Fell 1864 May 14 8 P. M.	Stone. Carbonaceous chondrite. Mass with crust. Cat. No. 1743.	32
		Fragments with crust. Cat. No. 1744.	30
		Fragments, some with crust. Cat. No. 509.	20
		Ornans, Doubs, France.	
449	Fell 1868 July 11	Stone. Spherical chondrite. Fragment with crust. Cat. No. 1766.	49
		Fragment sawed from interior. Resembles a lump of hardened, sandy mud. Cat. No. 294.	19
		Fragment with crust. Cat. No. 1767.	18
		Oroville, Butte Co., California.	
450	Found 1893	Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 859.	315
		Full-sized, etched section. Troilite occurs in elongated masses. Cat. No. 860.	262
		Orvinio, Perugia, Italy.	
451	Fell 1872 Aug. 31 5:15 A. M.	Stone. Orvinite. Three fragments with crust. Cat. No. 1651.	38
		Oscuro Mountains, Socorro Co., New Mexico.	
452	Found 1895	Iron. Coarse octahedrite. End piece, etched. Cat. No. 855.	640
		Etched section with crust. Cat. No. 457.	113
		Ottawa, Franklin Co., Kansas.	
453	Fell 1896 April 9	Stone. Howarditic chondrite. Two masses with crust. Cat. No. 1692.	72
		Mass with crust. Cat. No. 1691.	36
		Fragment with crust. Cat. No. 757.	1
		Pacula, Hidalgo, Mexico.	
454	Fell 1881 June 18 Morning	Stone. Brecciated white chondrite. Mass with crust. Cat. No. 1615.	92
		Mass with crust. Cat. No. 1616.	88
		Palezieux, see Chervettaz.	
		Pampa de Agua Blanca, Chile.	
455		Stone. Much oxidized fragment with crust. Nothing further seems to be known of this meteorite. Cat. No. 1901.	9

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
456	Found 1887	**Pan de Azucar,** Tarapaca, Chile.	
		Iron. Coarse octahedrite. Full-sized slab, etched. The bands are swollen. Cat. No. 1133.	210
457	Fell 1857 Feb. 28 Noon	**Parnallee,** Madras, India.	
		Stone. Veined gray chondrite. Mass with crust and polished surface. Cat. No. 1848.	486
		Mass with crust and polished surface. Abundant troilite. Cat. No. 437.	167
		Thin slab with crust. Cat. No. 1847.	160
		Polished slab with large nodule of troilite. Cat. No. 1846.	18
		Fragment with crust. Cat. No. 270.	3
458	Found 1885	**Pavlodar,** Tomsk, Russia.	
		Iron-stone. Pallasite. End piece with polished surface. Cat. No. 1313.	1,360
459	Fell 1826 May 19	**Pavlograd,** (Mordvinovka), Ekaterinoslav, Russia.	
		Stone. White chondrite. Sawed mass from interior. Much oxidized. Cat. No. 1644.	90
		Fragment from interior. Not oxidized. Cat. No. 448.	15
		Fragment with crust. Cat. No. 1645.	6
460	Fell 1882 Aug. 2 4:30 P. M.	**Pavlovka,** Saratowsk, Russia.	
		Stone. Howardite. Mass with crust. Cat. No. 1378.	94
		Mass from interior. Cat. No. 1377.	73
		Penkarring Rock, see Youndegin.	
461	Fell 1899 7 A. M.	**Peramiho,** Songea, West Africa.	
		Stone. Eukrite. Fragment with crust. Cat. No. 1679.	1
462	Found 1906	**Perryville,** Perry Co., Missouri.	
		Iron. Finest octahedrite. Full-sized section, etched. Cat. No. 802.	182
463	Found 1903	**Persimmon Creek,** Cherokee Co., North Carolina.	
		Iron. Finest octahedrite. Polished section with crust. Cat. No. 614.	165
		Full-sized, etched section. The peculiar structure and constituents of this iron are well shown. Cat. No. 970.	126
464	Fell 1855 Aug. 5 3:30 P. M.	**Petersburg,** Lincoln Co., Tennessee.	
		Stone. Howardite. Mass with crust. Cat. No. 1356.	205
		Fragment with crust. Cat. No. 1357.	9
465	Found 1841	**Petropavlovsk,** Smolensk, Russia.	
		Iron. Medium octahedrite. Slab from surface, etched. Cat. No. 1115.	46

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
466	Fell 1887 Sept. 12	**Phu Long,** French Indo-China. Stone. Veined spherulitic chondrite. Polished slab with crust. Cat. No. 1618.	11
467	Found 1908	**Pickens County,** Georgia. Stone. Crystalline chondrite. Mass with crust. Cat. No. 836.	312
		Mass with crust. Cat. No. 837.	68
468	Fell 1863 Aug. 8 12:30 P. M.	**Pillistfer,** Kurland, Russia. Stone. Crystalline chondrite. Mass with crust. Cat. No. 1646.	39
		Mass with crust and polished surface. Metal abundant. Cat. No. 1647.	29
		Fragment from interior. Cat. No. 279.	1
469	Found 1887	**Pipecreek,** Brandera Co., Texas. Stone. Veined crystalline chondrite. About one-third the original mass. One surface polished. Cat. No. 1580.	3,855
		Mass with crust and polished surfaces. Cat. No. 1579.	368
		Irregular fragment with one polished surface. Cat. No. 337.	84
470	Fell 1882 Aug. 29	**Pirgunje,** Bengal, India. Stone. Veined white chondrite. Mass with crust. Contains vein of troilite. Cat. No. 1639.	28
471	Fell 1884 Feb. 9 2:30 P. M.	**Pirthalla,** Punjaub, India. Stone. Brecciated spherical chondrite. Fragment with crust. Cat. No. 1643.	1
472	Found 1850	**Pittsburg,** Allegheny Co., Pennsylvania. Iron. Coarsest octahedrite. Etched fragment with crust. Cat. No. 1187.	22
		Etched fragment with crust. Cat. No. 823.	14
		Etched fragment with crust. Cat. No. 433.	4
473	Found 1913	**Plainview,** Hale Co. Texas., Stone. Chondrite. Complete individual. See Plate LXIV. Cat. No. 1968.	2,000
474	Fell 1723 June 22	**Ploschkowitz,** Bunzlau, Bohemia. Stone. Brecciated spherulitic chondrite. Fragment from interior. Cat. No. 1617.	2
		Fragments with crust. Cat. No. 493.	2
475	Found 1893	**Plymouth,** Marshall Co., Indiana. Iron. Medium octahedrite. Full-sized section, etched. Cat. No. 1130.	626
		Full-sized section, etched. Cat. No. 1131.	464
476	Fell 1868 June 30 3 P. M.	**Pnompehn,** Cambodia, French Indo-China. Stone. White chondrite. Fragments from interior. Cat. No. 1597.	2

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
477	Fell 1819 Oct. 13 8 A. M.	**Pohlitz,** Reuss-Gera, Germany. Stone. Veined white chondrite. Three fragments with crust. Cat. No. 1624.	11
478	Found 1863	**Ponca Creek,** (Dakota), Nebraska. Iron. Coarsest octahedrite. Full-sized slab, etched. Shows hieroglyphic and vein-like inclusions of schreibersite. Cat. No. 929.	305
479	Found 1893	**Prairie Dog Creek,** Decatur Co., Kansas. Stone. Spherical crystalline chondrite. Mass with crust. Cat. No. 1337. Mass with crust. Cat. No. 1338. Mass from interior. Shows single chondrus 1 mm. in diameter. Cat. No. 563.	94 63 18
480	Found 1797	**Prambanan,** Java. Iron. Fine octahedrite. Etched fragment with crust. The figures are well defined and there are numerous elongated inclusions. Cat. No. 1160.	16
481	Fell 1893 Feb. 13	**Pricetown,** Highland Co., Ohio. Stone. White chondrite. Fragment with crust. Crust thick and shining. Cat. No. 1768.	4
482	Fell 1863 Mar. 16 Afternoon	**Pulsora,** Indore, India. Stone. Brecciated intermediate chondrite. Fragment from interior. Nearly black in color. Amorphous, with large chrysolite crystals. The specimen is far from having the characters of an intermediate chondrite. Cat. No. 1638.	5
483	Fell 1868 Jan. 30 7 P. M.	**Pultusk,** Poland. Stone. Veined gray chondrite. Complete individual. Cat. No. 1581. One hundred and ten small individuals. Cat. No. 1585. Forty-nine small individuals. Cat. No. 290. Two medium-sized individuals. Cat. No. 1583. Individual showing primary and secondary crust. Cat. No. 1588. Seven medium-sized individuals. Cat. No. 291, 292. Medium-sized individual. Cat. No. 1582. Part of a large individual. Cat. No. 289. Medium-sized individual. Cat. No. 1584. Individual with armored and smoked surface. Cat. No. 1586. Individual cut in two and surfaces polished. Cat. No. 1587.	7,938 2,385 740 697 650 506 354 350 275 230 166

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Puquios, Chile.	
[4]84	Found 1885	Iron. Medium octahedrite. Nearly full-sized section, etched. Cat. No. 1106.	171
		Full-sized slab, etched. Irregular figures are dimly brought out by etching, also flakes of schreibersite. Cat. No. 377.	154
		Etched slab with crust. Cat. No. 1105.	71
		Putnam County, Georgia.	
[4]85	Found 1839	Iron. Fine octahedrite. Polished slab with crust. Cat. No. 892.	28
		Cleavage piece, oxidized. Cat. No. 893.	22
		Cleavage piece with taenite. Cat. No. 44.	4
		Quenggouk, Lower Burmah, India.	
[4]86	Fell 1857 Dec. 27 2:30 A. M.	Stone. Spherulitic chondrite. Mass with crust. One chondrus is 9 mm. in diameter. Cat. No. 1614.	300
		Quesa, Valencia, Spain.	
[4]87	Fell 1898 Aug. 1 9 P. M.	Iron. Fine octahedrite. Etched fragment. Cat. No. 1169	1
		Quincay, Vienna, France.	
[4]88	Fell 1851 Summer	Stone. Brecciated gray chondrite. Two fragments with crust and polished surfaces. Cat. No. 1657.	11
		Quinn Canyon, Nye Co., Nevada.	
[4]89	Found 1908	Iron. Medium octahedrite. Complete individual. Cat. No. 775. Gift of R. T. Crane, Jr., Stanley Field, Cyrus H. McCormick and George F. Porter.	1,450,000
		Rafruti, Berne, Switzerland.	
[4]90	Found 1886	Iron. Ataxite. Two slabs with crust, etched. Cat. No. 1136.	10
		Rakowka, Tula, Russia.	
[4]91	Fell 1878 Nov. 20.	Stone. Intermediate chondrite. Mass with crust. Cat. No. 1654.	163
		Rancho de la Pila, Durango, Mexico.	
[4]92	Found 1882	Iron. Medium octahedrite. Etched section with crust on three edges. Bands long and straight. Cat. No. 1172.	74
		The above specimen was labeled Cacaria by Ward but has the characters assigned to Rancho de la Pila.	
		Rancho de la Presa, Michoacan, Mexico.	
[4]93	Fell 1899	Stone. Spherulitic chondrite. Fragment with crust. Crust black, interior dark gray, chondritic. Cat. No. 1671.	3

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
494	Found 1810	**Rasgata,** Boyaca, U. S. of Colombia.	
		Iron. Ataxite. Polished section. Cat. No. 571.	97
		Mass with crust and polished surface. The crust surface is covered with only a slight coating of black oxide and shows terrestrial pitting. Cat. No. 1156.	95
		Polished fragment. Cat. No. 435.	2
495	Found 1808	**Red River,** Texas. (Gibbs meteorite.)	
		Iron. Medium octahedrite. Chiseled fragment, one end etched. Symmetrical figures are shown. Cat. No. 34.	55
		Etched fragment with crust. Cat. No. 917.	32
		Small, etched slab. Cat. No. 918.	22
496	Found 1895	**Reed City,** Osceola Co., Michigan.	
		Iron. Hammond octahedrite. Kidney-shaped end piece 8x23 cm., etched. Cat. No. 1042.	2,040
		Full-sized, etched section, 9x26 cm. Cat. No. 1041.	882
		Etched section with crust. Cat. No. 560.	137
497	Fell 1824 June 15 8:30 P. M.	**Renazzo,** Ferrara, Italy.	
		Stone. Black chondrite. Two fragments with crust. Cat. No. 1656.	7
498	Found 1900	**Rhine Villa,** South Australia.	
		Iron. Medium octahedrite. Full-sized, etched section. The bands are short and swollen. Cat. No. 869.	155
497	Fell 1828 June 4 8:30 A. M.	**Richmond,** Henrico Co., Virginia.	
		Stone. Crystalline spherical chondrite. Section with crust, polished. Cat. No. 1735.	35
		Fragment from interior. Cat. No. 239.	2
500	Fell 1876 Dec. 21 8:45 P. M.	**Rochester,** Fulton Co., Indiana.	
		Stone. Spherulitic chondrite. Two fragments with crust. Cat. No. 1636.	1
501	Fell 1871 Spring	**Roda,** Huesca, Spain.	
		Stone. Rodite. Mass with crust. The crust on one surface is of the eukritic order. Cat. No. 1376.	26
502	Found 1852	**Rodeo,** Durango, Mexico.	
		Iron. Fine octahedrite. About one-half of the original mass. One surface etched. Cat. No. 590.	25,821
		Full-sized, etched section. Cat. No. 1951.	1,812
		Full-sized, etched section. Cat. No. 1129.	1,502
		Full-sized, etched section. Cat. No. 1128.	1,105

[No].	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Roebourne, Queensland, Australia.	
[..]3	Found 1892	Iron. Medium octahedrite. Full-sized, etched section. 6 cm. thick. Cat. No. 873.	19,390
		End piece, 20 cm. long, etched. Cat. No. 874.	13,718
		Full-sized, etched section. Cat. No. 872	5,224
		Full-sized, etched section, 10x22 cm. Cat. No. 460.	1,480
		Rosario, Honduras.	
[..]4	Found 1897	Iron. Coarse octahedrite. Full-sized, etched section. Cat. No. 1132.	460
		Rowton, Shropshire, England.	
[..]5	Fell 1876 April 20 3:15 P. M.	Iron. Medium octahedrite. Fragment with crust and etched surfaces. Cat. No. 1164.	13
		Ruff's Mountain, Lexington Co., South Carolina.	
[..]6	Found 1844	Iron. Medium octahedrite. Mass with crust and etched surfaces. Cat. No. 1170.	118
		Mass with crust and etched surfaces. Cat. No. 1171.	117
		Rushville, Franklin Co., Indiana.	
[..]7	Found 1866	Stone. Gray chondrite. Mass from interior. Cat. No. 1672.	19
		Fragment with crust. Cat. No. 1673.	1
		Russel Gulch, Gilpin Co., Colorado.	
[..]8	Found 1863	Iron. Fine octahedrite. Etched slab with crust. Cat. No. 1157.	277
		Sacramento Mountains, Eddy Co., New Mexico.	
[..]9	Found 1896	Iron. Medium octahedrite. Full-sized, etched section, 15x53 cm. Cat. No. 875.	6,122
		Full-sized, etched section, 12x40 cm. Shows typical well-defined, octahedral figures, and two large nodules of troilite, one of which is perforated. Cat. No. 465.	2,330
		Saint Caprais de Quinsac, Gironde, France.	
[..]10	Fell 1863 Jan. 28 2:45 P. M.	Stone. Intermediate chondrite. Fragment from interior. Cat. No. 1668.	4
		Saint Christophe la Chartreuse, Vendee, France.	
[..]11	Fell 1841 Sept. 6	Stone. White chondrite. Slice with crust. Cat. No. 1693.	9
		Saint Denis Westrem, Belgium.	
[..]12	Fell 1855 June 7 7:45 P. M.	Stone. Veined spherulitic chondrite. Two fragments with crust. Cat. No. 1642.	13
		Saint Francois County, Missouri.	
[..]13	Found 1863	Iron. Coarse octahedrite. Full-sized, etched section. Cat. No. 866.	753

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Saint Genevieve County, Missouri.	
514	Found 1888	Iron. Fine octahedrite. About one-half the original mass. Two etched surfaces. Cat. No. 1049.	98,428
		Full-sized, etched section. Cat. No. 1048.	7,701
		Etched slab, 9x12 cm. Gift of Prof. H. A. Ward. Cat. No. 512.	790
		Saint Germain en Puel, Ille et Villain, France.	
515	Fell 1890 July 4 3:30 P. M.	Stone. Spherulitic chondrite. Mass with crust. Cat. No. 805.	106
		Saint Mesmin, Aube, France.	
516	Fell 1866 May 30 3:20 A. M.	Stone. Brecciated intermediate chondrite. Mass with crust. Cat. No. 612.	32
		Four fragments, two with crust. Cat. No. 1722.	21
		Saint Michel, Finland.	
517	Fell 1910 July 12 7:30 P. M.	Stone. Rodite. Mass with crust. Cat. No. 1947.	235
		Saline, Sheridan Co., Kansas.	
518	Fell 1898 Nov. 15 9:30 P. M.	Stone. Crystalline spherical chondrite. About two-thirds of the original individual. Crust black, with metallic points and one large globule of metal. Interior compact, greenish-black in color, and showing abundant metallic grains. Cat. No. 527.	19,500
		Mass with crust and polished surface. Cat. No. 1333.	1,360
		Mass with crust. Cat. No. 1334.	1,042
		Salles, Rhone, France.	
519	Fell 1798 Mar. 12 6 P. M.	Stone. Veined intermediate chondrite. Mass with crust and sawed surface. A well-marked, brecciated structure is apparent. Cat. No. 1723.	109
		Salt Lake City, Utah.	
520	Found 1869	Stone. Brecciated gray chondrite. Mass with crust and polished surfaces. Cat. No. 1859.	123
		Salt River, Bullitt Co., Kentucky.	
521	Found 1850	Iron. Finest octahedrite. Etched mass with crust. The octahedral structure is only discernible under a lens. Cat. No. 1141.	79
		San Angelo, Tom Green Co., Texas.	
522	Found 1897	Iron. Medium octahedrite. Full-sized, etched section. Cat. No. 965.	2,551
		Full-sized, etched section. One troilite nodule. Cat. No. 964.	1,814
		Full-sized, etched section, 12x27 cm. Shows typical octahedral figures, with circular and elongated inclusions of troilite, the latter often distributed in a vein-like manner. Cat. No. 478.	1,501

o.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
23	Found 1896	**San Cristobal,** Atacama, Chile. Iron. Ataxite. End piece, etched. The crust surface is deeply pitted and smooth. Cat. No. 1146.	114
24	Recognized 1887	**San Emigdio,** San Bernardino Co., California. Stone. Spherical chondrite. Mass with crust (?) and polished surface. A section of a nickel-iron chondrus, 5 mm. in diameter is a feature. Cat. No. 1713. Fragments from interior, one bearing crust. Cat. Nos. 446, 451.	24 15
25	Found 1868	**San Francisco del Mezquital,** Durango, Mexico. Iron. Ataxite. Etched slab with crust. Cat. No. 1135.	12
26	Found 1887	**San Pedro Springs,** Bexar Co., Texas. Stone. White chondrite. Fragment with crust and polished surface. Cat. No. 1666.	3
27	Found 1872	**Santa Apolonia,** Tlascala, Mexico. Iron. Medium octahedrite. Etched slab with crust. Figures octahedral, bands long and straight. Cat. No. 1010.	212
28	Fell 1899 Feb. 12 7 A. M.	**Santa Barbara,** Rio Grande do Sul, Brazil. Stone. Gray chondrite. Mass with crust. Cat. No. 1851.	41
29	Found 1824	**Santa Rosa,** Colombia. Iron. Brecciated octahedrite. End piece with etched surfaces. Cat. No. 1945. Polished slab with numerous troilite inclusions. Cat. No. 762.	98,200 1,080
30	Known 1883	**São Julião de Moreira,** Minho, Portugal. Iron. Brecciated hexahedrite. Full-sized, polished section, 13x27 cm., with crust. Shows coarse, irregular inclusions of schreibersite. Cat. No. 556. Full-sized, etched section. Cat. No. 1104. Full-sized, etched section. Cat. No. 1103. Etched fragment with crust. Cat. No. 536.	1,782 785 181 30
31	Found 1854	**Sarepta,** Saratov, Russia. Iron. Coarse octahedrite. Etched section with crust. Cat. No. 1145.	286
32	Fell 1868 Sept. 8 2:30 A. M.	**Sauguis,** Basses-Pyrénées, France. Stone. Veined white chondrite. Fragments from interior. Cat. No. 1711. Fragment with crust and polished surface. Cat. No. 295.	11 4

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
533	Fell 1894 July 27 8 P. M.	**Sawtschenskoje,** Cherson, Russia. Stone. Crystalline spherulitic chondrite. Mass with crust. Cat. No. 1852.	25
543	Fell 1715 April 11 4 P. M.	**Schellin,** Prussia, Germany. Stone. Veined intermediate chondrite. Fragment from interior. Cat. No. 1600.	0.5
535	Fell 1814 Jan. 23 Noon	**Scholokov,** (Bachmut), Ekaterinoslaw, Russia. Stone. Veined white chondrite. Fragment with crust. Cat. No. 1724.	5
536	Fell 1846 Dec. 25 2:45 P. M.	**Schönenberg,** Swabia, Bavaria. Stone. Veined white chondrite. Thin slab with crust. Contains large nodule of troilite. Cat. No. 1853.	24
		Fragment with crust. Cat. No. 254.	8
537	Found 1850	**Schwetz,** Prussia, Germany. Iron. Medium octahedrite. Etched slab with crust. Cat. No. 1163.	92
538	Found 1905	**Scott City,** Scott Co., Kansas. Stone. Nearly complete individual with one polished surface. Cat. No. 1957.	1,725
		Complete individual. Cat. No. 1958.	135
539	Found 1867	**Scottsville,** Allen Co., Kentucky. Iron. Hexahedrite. End piece, etched. Cat. No. 1043.	1,150
		Full-sized slab, 12x17 cm. etched. Cat. No. 91.	364
540	Fell 1871 May 21 8:15 A. M.	**Searsmont,** Waldo Co., Maine. Stone. Spherical chondrite. Fragment with crust. Cat. No. 1710.	5
		Fragments from interior. Cat. Nos. 302–3.	3
541	Found 1847	**Seeläsgen,** Brandenburg, Prussia. Iron. Coarsest octahedrite. Etched slab. Cat. No. 1055.	623
		Cuboidal mass with crust and etched surfaces. Cat. No. 1054.	374
		Chiseled fragment. Cat. No. 57.	41
		Etched slab. Cat. No. 375.	12
542	Fell 1853 Mar. 6 Noon	**Segowlee,** Bengal, India. Stone. Crystalline chondrite. Broad mass with crust and polished surface. The crust surface is broadly concave. Cat. No. 1865.	166
		Slice from interior with polished surfaces. Much oxidized. Cat. No. 1863.	11
		Fragments from interior. Cat. No. 1864.	7
543	Found 1906	**Selma,** Dallas Co., Alabama. Stone. Spherulitic chondrite. Mass from interior with polished surface. The stone takes a good polish. Color dark. Cat. No. 1868.	24

Io.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Sena, (Sigena), Aragon, Spain.	
44	Fell 1773 Nov. 17 Midnight	Stone. Brecciated gray chondrite. Fragment from the interior. Compact, mottled white, gray, and brown from presence of chondri and rusty metallic grains. Cat. No. 445.	5
		Two fragments, one with crust. Interior dark gray. Cat. No. 1854.	4
		Seneca Falls, Seneca Co., New York.	
45	Found 1850	Iron. Medium octahedrite. Sawed section showing natural surface and fracture. Octahedral cleavage very distinct. One surface partially etched, bears an initial of the name of the first owner, Mr. L. C. Partridge. Loaned by Gen. G. Murray Guion. Cat. No. 60.	300
		Full-sized section, etched. Contains a circular nodule of troilite. Cat. No. 1200.	104
		Senhadja, Algiers, Africa.	
46	Fell 1865 Aug. 25 11 A. M.	Stone. Veined white chondrite. Mass with crust. Cat. No. 1837.	284
		Mass from interior. Cat. No. 599.	50
		Fragment from interior. Cat. No. 283.	1
		Seres, Macedonia, Turkey.	
47	Fell 1818 June	Stone. Gray chondrite. Mass with interior. Cat. No. 1866.	39
		Mass with polished surfaces. Cat. No. 1867.	7
		Serrania de Varas, Atacama, Chile.	
48	Found 1875	Iron. Fine octahedrite. Mass with crust and etched surface. The figures of the etched surface resemble those of Butler. Different figures appear also on a portion. The figures differ from those described by Brezina and Fletcher. Cat. No. 950.	31
		Rough fragment. Cat. No. 951.	10
		Sevilla, Spain.	
49	Fell 1862 Oct. 1	Stone. Howarditic chondrite. Fragments with crust. Cat. No. 1601.	0.2
		Sevrukowo, Kursk, Russia.	
50	Fell 1874 May 11 11:45 P. M.	Stone. Black chondrite. Mass from interior with polished surface. Cat. No. 1602.	140
		Like previous specimen. Cat. No. 1603.	51
		Shalka, Bengal, India.	
51	Fell 1850 Nov. 30 4:30 A. M.	Stone. Chladnite. Fragments with crust. Cat. No. 572.	11
		Fragment with crust. Cat. No. 1367.	9

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Shelburne, Ontario, Canada.	
552	Fell 1904 Aug. 13 8 P. M.	Stone. Veined gray chondrite. Half of small individual. Cat. No. 606.	5,549
		Mass with crust and two polished surfaces. A large, forked, metallic vein is an interesting feature. Cat. No. 1336.	1,700
		Full-sized section. Cat. No. 1953.	338
		End piece. Cat. No. 1952.	175
		Shergotty, (Umjhiawar), Bengal, India.	
553	Fell 1865 Aug. 25 9 A. M.	Stone. Shergottite. Mass with crust. Crust shining and black. Cat. No. 1372.	40
		Shingle Springs, El Dorado Co., California.	
554	Found 1869	Iron. Ataxite. Etched section with crust. Cat. No. 1137.	117
		Shrewsbury, York Co., Pennsylvania.	
555	Found 1907	Iron. Medium octahedrite. Etched section. Cat. No. 776.	88
		Section. Cat. No. 777.	21
		Shytal, Bengal, India.	
556	Fell 1863 Aug. 11 Noon	Stone. Brecciated intermediate chondrite. Two fragments with polished surfaces. Cat. No. 1697.	14
		Fragment from interior. Cat. No. 1696.	8
		Siena, Tuscany, Italy.	
557	Fell 1794 June 16 7 P. M.	Stone. Howarditic chondrite. Mass with crust. Cat. No. 1698.	52
		Mass with polished surface. Cat. No. 1699.	13
		Sierra Blanca, Chihuahua, Mexico.	
558	Found 1784	Iron. Coarse octahedrite. Two fragments. Cat. No. 1144.	1
		Silver Crown, Laramie Co., Wyoming.	
559	Found 1887	Iron. Coarse octahedrite. Etched slab with crust. Cat. No. 995.	75
		Etched slab with crust. Structure closely crystalline, with a few rectangular figures. Lines of taenite very distinct. Cat. No. 130.	71
		Sindhri, Bombay, India.	
560	Fell 1901 June 10	Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1339.	433
		Mass with crust. Cat. No. 573.	351
		Fragment from interior. Cat. No. 1340.	15
		Sitathali, Rajputana, India.	
561	Fell 1875 Mar. 4	Stone. Howarditic chondrite. Two fragments with crust and sawed surfaces. Cat. No. 1695.	14
		Ski, Akershuss, Norway.	
562	Fell 1848 Dec. 27 Evening.	Stone. Veined white chondrite. Fragment from interior. Cat. No. 1667.	1

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
563	Fell 1868 May 22 10:30 A. M.	**Slavetic,** Croatia, Austria. Stone. Brecciated gray chondrite. Mass with crust and polished surface. Cat. No. 1665.	11
564	Fell 1818 Aug. 10	**Slobodka,** Smolensk, Russia. Stone. Spherulitic chondrite. Fragment from interior. Cat. No. 1694.	12
565	Found 1839	**Smithland,** Livingston Co., Kentucky. Iron. Ataxite. Mass worked into form of a wedge. Cat. No. 1162. Torn fragment, etched. Cat. No. 1161.	49 22
566	Found 1863	**Smith's Mountain,** Rockingham Co., North Carolina. Iron. Fine octahedrite. Large etched section. Cat. No. 452. Full-sized section, etched. The bands meet nearly at right angles. Cat. No. 1107. Etched section. Cat. No. 85.	231 214 17
567	Found 1840	**Smithville,** (Caryfort), Dekalb Co., Tennessee. Iron. Coarse octahedrite. Full-sized, etched section, 13x19 cm. Cat. No. 1026. End piece, etched. The iron "sweats" profusely. Cat. No. 1027. Thin slab, etched. Shows troilite and cohenite. Cat. No. 50.	1,871 1,814 55
568	Fell 1877 Oct. 13 2 P. M.	**Sokobanja,** near Alexinac, Servia. Stone. Spherical chondrite. Mass from interior. Cat. No. 1373. Mass from interior, showing inclusions of a less chondritic character. Cat. No. 1374. Irregular fragment of light-gray color, showing chondri, some of which are 2 mm. in diameter. Cat. No. 319.	243 75 33
569	Fell 1866 June 7	**Sone Mura,** Tampa, Japan. Stone. Crystalline chondrite. Fragment with crust. Crust shining, black. Cat. No. 1669.	1
570	Found 1893	**South Bend,** St. Joseph Co., Indiana. Iron-stone. Pallasite. Nearly complete individual. Cat. No. 607. Full-sized section. Cat. No. 1954. End piece with polished and etched surfaces. Cat. No. 1309.	2,174 172 117
571	Found 1873	**Ssyromolotow,** Jeniseisk, Russia. Iron. Medium octahedrite. Torn fragment, etched. Cat. No. 1147. Thin slab, etched. Cat. No. 1148.	22 5

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Ställdalen, Sweden.	
572	Fell 1876 June 28 11:30 A. M.	Stone. Brecciated gray chondrite. Mass with crust and armored surfaces. Cat. No. 1658.	341
		Irregular mass, with crust and polished surface. Interior brownish-black. Compact, with numerous metallic grains. There seems to be reason to doubt whether this specimen is Ställdalen. Cat. No. 316.	50
		Fragment with crust. Cat. No. 315.	3
		Stannern, Moravia, Austria.	
573	Fell 1808 May 22 6 A. M.	Stone. Eukrite. Mass with crust. Cat. No. 1363.	400
		Mass with crust. The fusible nature of the crust is well shown. Cat. No. 1362.	272
		Nearly complete individual. Shows both primary and secondary crust. Cat. No. 1361.	75
		Staunton, Augusta Co., Virginia.	
574	Found 1858	Iron. Medium octahedrite. End piece, etched. Cat. No. 1096.	1,644
		Full-sized, etched section. Shows crescent-shaped nodule of troilite. Cat. No. 78.	1,595
		Full-sized, etched section. Cat. No. 1095.	1,260
		Etched section. Cat. No. 79.	665
		Broad, etched section. Cat. No. 1094.	600
		Etched mass. Cat. No. 80.	100
		Stavropol, Caucasus, Russia.	
575	Fell 1857 Mar. 24 5 P. M.	Stone. Crystalline chondrite. Three fragments from interior of dark color and with polished surfaces. The classification apparently should be black chondrite. Cat. No. 1883.	26
		Steinbach, Saxony, Germany.	
576	Found 1724	Iron-stone. Siderophyr. Thin slab, polished. The stony portion exceeds the metallic. Cat. No. 164.	33
		Breitenbach.	
	Found 1861	Thin, polished fragment. Resembles the Steinbach specimen very closely. Cat. No. 169.	1
		Rittersgrün.	
		Slab with crust, polished and etched. Cat. No. 1321.	150
		Fragment with polished surfaces. Cat. No. 1322.	45
		Summit, Blount Co., Alabama.	
577	Found 1890	Iron. Granular hexahedrite. Etched section with crust. Cat. No. 1149.	39
		Supuhee, Gorukhpur, India.	
578	Fell 1865 Jan. 19	Stone. Brecciated gray chondrite. Polished fragment with crust. Cat. No. 1880.	13
		Fragment with crust. Cat. No. 1881.	5

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
579	Found 1899	**Surprise Springs,** San Bernardino Co., California. Iron. Medium octahedrite. End piece, etched. Cat. No. 854.	1,008
580	Fell 1753 June 3 8 P. M.	**Tabor,** Bohemia, Austria. Stone. Brecciated spherulitic chondrite. Mass with crust. Cat. No. 1856.	60
		Full-sized section, polished. Metal abundant. Cat. No. 1857.	55
581	Fell 1877 Aug. 30 3 P. M.	**Tabory,** (Ochansk), Perm, Russia. Stone. Brecciated spherical chondrite. Mass with crust. Cat. No. 1443.	8,845
		Mass with crust. Cat. No. 1442.	2,400
		Mass from interior. Cat. No. 1441.	1,958
		Fragment from interior. An inclusion of nickel-iron shows approximations to crystal planes on its surface. Cat. No. 1440.	93
		Fragment with crust. Cat. No. 335.	23
582	Found 1891	**Tajgha,** Jeniseisk, Russia. Iron. Medium octahedrite. Etched fragment with crust. Cat. No. 1167.	46
		Thin slab, etched. Cat. No. 1168.	18
583	Found 1875	**Taltal,** Atacama, Chile. Stone. Much oxidized fragment. Said by Wülfing to be same as Vaca Muerta. Cat. No. 1879.	16
584	Found 1903	**Tamarugal,** (El Inca), Lagunas, Chile. Iron. Medium octahedrite. Square slab with crust, polished and etched surfaces. Cat. No. 819.	830
585	Found 1880	**Tanogami,** Omi, Japan. Iron. Medium octahedrite. Etched slab with crust. The figures are of a swollen character. Cat. No. 1150.	163
586	Found 1853	**Tazewell,** Claiborne Co., Tennessee. Iron. Finest octahedrite. Torn mass. Cat. No. 867.	197
		Slab with polished surfaces. Cat. No. 868.	82
587	Found 1784	**Tennant's Iron.** Mineral collection of Academy near Moscow, Russia. Iron. Coarse octahedrite. Etched slab with crust. Cat. No. 1166.	29
588	Fell 1872 June 28 Noon	**Tennasilm,** Ehstland, Russia. Stone. Veined spherulitic chondrite. Mass from interior. Cat. No. 1874.	63

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
589	Found 1909	**Tepl,** Bohemia. Iron. Medium octahedrite. Etched section with crust. Figures well-marked and there are numerous Reichenbach lamellae. Cat. No. 803.	45
590	Found 1891	**Ternera,** Atacama, Chile. Iron. Ataxite. Fragment. Cat. No. 1176.	1
591	Found 1886	**Thunda,** Queensland, Australia. Iron. Medium octahedrite. Thick slab with crust, dimly etched. Cat. No. 994. Etched section. Bands very long and straight. Cat. No. 993. Sawed slab, one surface etched. Figures distinct and regular. Cat. No. 128.	1,148 181 154
592	Found 1888	**Thurlow,** Hastings Co., Ontario, Canada. Iron. Fine octahedrite. End piece, etched. Cat. No. 870.	209
593	Fell 1878 July 15. 1:45 P. M.	**Tieschitz,** Moravia, Austria. Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1725. Mass with crust and polished surface. Cat. No. 1726.	28 27
594	Fell 1807 Mar. 25 3 P. M.	**Timochin,** Smolensk, Russia. Stone. Spherulitic chondrite. Mass with crust and polished surface. Cat. No. 1727. Mass from interior with sawed surfaces. Cat. No. 1728.	37 18
595	Fell 1869 Sept. 19 9 P. M.	**Tjabe,** Java. Stone. Crystalline chondrite. Mass with crust. Cat. No. 1704. Mass with crust and sawed surface. Cat. No. 1705.	47 23
596	Found 1903	**Tlacotepec,** Puebla, Mexico. Iron. Octahedrite(?) Full-sized, polished section. Cat. No. 1165.	138
597	Found 1810	**Tocavita,** U. S. of Columbia. Iron. Finest octahedrite. Fragment with crust and etched surfaces. The etching is typical of the finest octahedrites. Although the history of this iron is unknown according to Ward (Am. Jour. Sci., 1907, 4, 23, 1–8), its characters are so well marked that it seems desirable to include it in collections. Cat. No. 1155.	15

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Toluca, Mexico.	
598	Found 1784	Iron. Medium octahedrite. Complete individual of hemi-spheroidal form. Cat. No. 23.	46,040
		Complete individual of hemi-spheroidal form. Shows cleavage. Cat. No. 22.	28,038
		Complete individual of crescentic form. Contains considerable lawrencite. Cat. No. 27.	19,954
		Complete individual. Cat. No. 1202.	19,277
		Complete individual. Cat. No. 24.	18,025
		Nearly complete individual, with etched surface. 20x40 cm. Cat. No. 15.	16,665
		Nearly complete individual with etched surface, 18x40 cm. Cat. No. 1203.	16,213
		Complete individual. Cat. No. 1204.	8,607
		Nearly complete individual with etched surface, 13x20 cm. Cat. No. 16.	6,166
		Complete individual. Cat. No. 1207.	5,902
		Ten "hammer stones" from 1000 to 200 grams each in weight. Cat. Nos. 1212–1221.	5,339
		Etched section with abundant troilite. Cat. No. 1205.	4,813
		Complete individual. Cat. No. 1206.	4,611
		Full-sized, etched section, 17x17 cm. Cat. No. 370.	4,535
		Complete individual. Cat. No. 18.	3,000
		Complete individual of pyramidal form. Cat. No. 372.	2,506
		Etched section, 21x38 cm. Cat. No. 26.	2,423
		Series of nine specimens showing effect of heat and forging on specimens of the meteorite. Cat. Nos. 1224–32.	2,265
		Mass showing cleavage. Cat. No. 17.	1,997
		Etched section, 18x22 cm. Cat. No. 25.	1,900
		Complete individual. Cat. No. 20.	1,880
		Cube, 6 cm. on a side, etched. Cat. No. 1209.	1,359
		Complete individual. Cat. No. 21.	1,107
		End piece, etched. The figures are curved. Cat. No. 1210.	900
		Full-sized section, 10x21 cm. etched. Cat. No. 371.	823
		Complete individual of spheroidal form with one etched face. Cat. No. 12.	816
		End piece, etched. Cat. No. 1211.	620
		Complete individual of spheroidal form. Cat. No. 7	464
		Complete individual of spheroidal form. Cat. No. 9.	263
		Broad, thin, etched section. Cat. No. 1222.	260
		Complete individual. Shows use as a hammer. Cat. No. 10.	251
		Complete individual of spheroidal form. Cat. No. 11.	227
		Complete individual. Cat. No. 14.	225
		Complete individual showing cleavage. Cat. No. 13.	112
		Etched section. Cat. No. 1223.	90
		Complete individual of irregular form. Cat. No. 8.	99

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
599	Fell 1879 Sept. 17	**Tomatlan,** Jalisco, Mexico. Stone. Spherulitic chondrite. Fragments with crust. Cat. No. 1703.	8
600	Found 1859	**Tombigbee River,** Choctaw Co., Alabama. Iron. Granular hexahedrite. Etched section, 10x14 cm. Hieroglyphic schreibersite is present. Cat. No. 504. Full-sized, etched section. Cat. No. 1180.	1,690 506
601	Found 1863	**Tomhannock Creek,** Rensselaer Co., New York. Stone. Brecciated gray chondrite. Polished section. Metal abundant. Crust does not differ in color from interior. Darker and more compact than Homestead. Cat. No. 1760. Slice showing crust. Cat. No. 281. Polished fragment from interior. Cat. No. 280.	19 7 1
602	Found 1886	**Tonganoxie,** Leavenworth Co., Kansas. Iron. Medium octahedrite. End piece, etched. Cat. No. 988. Full-sized, etched section. Cat. No. 989. Full-sized, etched section 8x12 cm., with crust. Cat. No. 477. Etched section with crust. Cat. No. 832.	353 347 264 32
603	Found 1891	**Toubil,** Jeniseisk, Russia. Iron. Medium octahedrite. Segment with crust and three etched faces. Bands narrow and straight. Cat. No. 1143.	327
604	Fell 1812 April 12 1:30 P. M.	**Toulouse,** Haute Garonne, France. Stone. Veined intermediate chondrite. Complete individual. Interior brownish from oxidation. Cat. No. 1869. Fragment from interior. Cat. No. 1870.	14 12
605	Fell 1863 Dec. 7 11 A. M.	**Tourinnes-la-Grosse,** Belgium. Stone. White chondrite. Fragment with crust. Cat. No. 1796. Interior fragment. Cat. No. 1797. Interior fragment. Cat. No. 486.	11 9 3
606	Found 1890	**Travis County,** Texas. Stone. Black chondrite. Fragment from interior. Cat. No. 1714.	7
607	Found 1858	**Trenton,** Washington Co., Wisconsin. Iron. Medium octahedrite. End piece, etched. Cat. No. 1038. Full-sized section, etched. Cat. No. 1037. Thin section, etched. Cat. No. 81. Etched slab. Cat. No. 1036.	3,232 142 137 51

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
608	Fell 1856 Nov. 2 4 P. M.	**Trenzano,** Brescia, Italy. Stone. Veined spherical chondrite. Cubical fragment, with crust on two surfaces. Cat. No. 268.	57
		Fragment with crust. Cat. No. 1871.	31
		Fragment with crust. Cat. No. 325.	2
609	Recognized 1851	**Tucson,** Pima Co., Arizona. Iron. Ataxite. Etched fragment showing typical stippled appearance of this iron. Cat. No. 59.	12
		Ainsa-Signet. Full-sized, polished section. Cat. No. 858.	415
610	Found 1846	**Tula,** (Netschaevo), Russia. Iron. Brecciated octahedrite. Mass with crust and etched surfaces. Cat. No. 1152.	135
		Thin slab, etched. Cat. No. 1153.	30
		Thin slab from siliceous portion. Polished surface. Cat. No. 1154.	15
611	Fell 1884 May 20 8:30 P. M.	**Tysnes,** Tysnes Island, Norway. Stone. Brecciated intermediate chondrite. Mass with crust and armored surface. Cat. No. 1719.	428
		Fragment from interior. Texture compact and firm. There are also angular inclusions of a lighter color. Cat. No. 543.	28
612	Fell 1840 June 12 10:30 P. M.	**Uden,** North Brabant, Holland. Stone. White chondrite. Fragment with crust. Cat. No. 1715.	3
613	Fell 1866 April	**Udipi,** Malabar Coast, India. Stone. Veined gray chondrite. Fragment with crust and polished surface. Cat. No. 1701.	16
		Fragment from interior with polished surface. Cat. No. 1702.	8
614	Fell 1822	**Umballa,** Punjaub, India. Stone. Veined gray chondrite. Polished fragments with crust. Cat. No. 1717.	5
		Fragment from interior. Cat. No. 1718.	4
615	Found 1853	**Union County,** Georgia. Iron. Coarsest octahedrite. Cuboidal mass with crust and etched surfaces. No lamellae are visible. Cat. No. 1188.	67

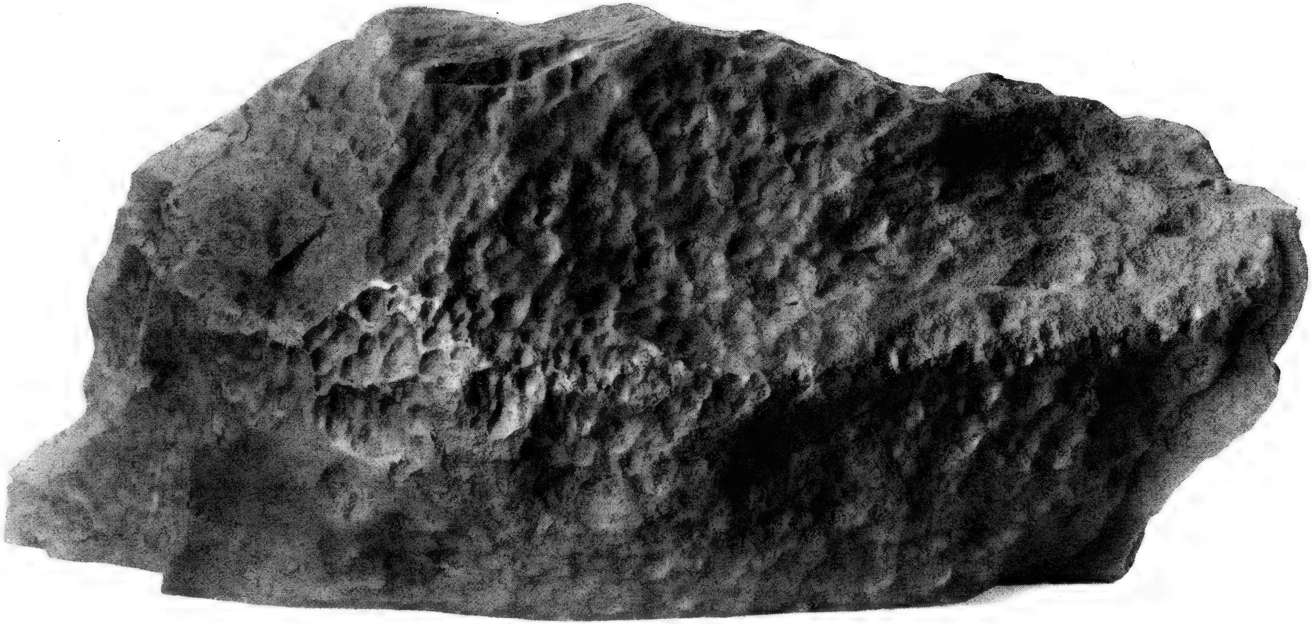
No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
616	Found 1894	**Ute Pass,** Summit Co., Colorado. Iron. Coarsest octahedrite. Slab 7x4 cm. with thick, oxidized crust on one side and etched surface on the other. There is no distinctive etching pattern visible to the naked eye, but with a lens a few taenite ribbons can be discerned at intervals. The history of this meteorite is unknown to the writer. Ward states in his 1904 catalogue that this specimen is "the largest in any collection." In his 1901 catalogue what is undoubtedly the same specimen is listed as "Mount Ouray, Chaffee Co., Colorado." Cat. No. 1112.	120
617	Fell 1843 June 2 8 P. M.	**Utrecht,** Holland. Stone. Veined spherulitic chondrite. Mass with crust. Cat. No. 1700. Mass with crust. Cat. No. 581.	109 50
618	Found 1908	**Uwet,** Southern Nigeria, Africa. Iron. Hexahedrite. Etched slab. Cat. No. 778.	372
619	Recognized 1861	**Vaca Muerta,** (Sierra de Chaco), Chile. Iron-stone. Mesosiderite. Full-sized section, polished. Metal abundant. Cat. No. 1284. Individual with polished surface. Cat. No. 1286. Fragment with crust. Cat. No. 170. Fragment with crust. Cat. No. 171.	170 68 17 14
620	Fell 1876 June 19	**Vavilovka,** Cherson, Russia. Stone. Rodite. Mass with crust. Cat. No. 1659. Two fragments with crust. Cat. No. 1660.	126 23
621	Fell 1880 May 1–15	**Veramin,** Teheran, Persia. Iron-stone. Mesosiderite. Mass with crust and polished surface. Cat. No. 1269. Two fragments with polished surfaces. Cat. No. 1268. Fragment from interior. Cat. No. 495.	813 23 8
622	Fell 1865 Mar. 26 9 A. M.	**Vernon County,** Wisconsin. Stone. Veined crystalline chondrite. Mass from interior with polished surface. Cat. No. 1706.	22
623	Found 1862	**Victoria West,** Cape Colony, Africa. Iron. Fine octahedrite. Etched slab with crust. Cat. No. 871.	17
624	Fell 1910 Jan. 22 10:30 A. M.	**Vigarano,** Italy. Stone. Black chondrite. Mass with crust. Cat. No. 782.	116

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
625	Fell 1874 May 20	**Virba,** Bulgaria. Stone. Veined white chondrite. Fragment with crust. Cat. No. 1716.	2
626	Fell 1831 May 13 11 P. M.	**Vouillé,** Vienne, France. Stone. Veined intermediate chondrite. Mass with crust and polished surface. Cat. No. 1663. Mass from interior. Polished. Cat. No. 1662.	453 210
627	Found 1874	**Waconda,** Mitchell Co., Kansas. Stone. Brecciated spherical chondrite. Mass from interior. Color varies in different portions. Cat. No. 309. Mass with crust. Cat. No. 1731. Sawed mass with crust. Cat. No. 1730. Mass with crust. Veined. Cat. No. 310. Weathered fragment. Cat. No. 311.	2,835 870 228 125 5
628	Fell 1864 Dec. 4	**Wairarapa,** Wellington, New Zealand. Stone. Crystalline chondrite. Mass with crust and polished surface. Color reddish-brown from oxidation. The crust surface is smooth as if from terrestrial erosion. Cat. No. 1882.	195
629	Found 1832	**Walker County,** Alabama. Iron. Hexahedrite. Etched section with crust. Cat. No. 914. Section with crust. Cat. No. 434.	40 32
630	Found 1887	**Wallen's Ridge,** (Waldron Ridge), Claiborne Co., Tennessee. Iron. Coarse octahedrite. End piece, etched. Cat. No. 1134.	427
631	Fell 1877 Jan. 3 7:15 A. M.	**Warrenton,** Warren Co., Missouri. Stone. Ornansite. Mass with crust. Cat. No. 1720.	117
632	Found 1898	**Weaver,** Maricopa Co., Arizona. Iron. Ataxite. Full-sized section, etched. Cat. No. 1158. Etched crust segment. Cat. No. 615.	394 372
633	Found 1888	**Welland,** Ontario, Canada. Iron. Medium octahedrite. Segment, 11.5x7.5 cm., showing etched and natural surfaces. A marked tendency to octahedral cleavage is apparent. Cat. No. 132. Thin slab, etched. Cat. No. 990. Full-sized, etched section. Cat. No. 991.	715 200 162

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Werchne Dnieprowsk, Ekaterinoslav, Russia.	
634	Found 1876	Iron. Finest octahedrite. Etched slab with crust. Contains nodule of troilite 2.5 cm. in diameter. The lamellae are too coarse for the classification and the iron does not show the tendency to rust said to be characteristic of this fall. Cat. No. 862.	99
		Werchne Tschirskaja, Russia.	
635	Fell 1843 Nov. 12	Stone. Veined spherulitic chondrite. Two fragments of about equal size, each with crust. One shows armored surface. Cat. No. 1873.	14
		Werchne Udinsk, Transbaikalin, Siberia.	
636	Found 1854	Iron. Medium octahedrite. Cuboidal, etched mass with crust. Cat. No. 1138.	219
		Etched slab with crust. Cat. No. 1139.	75
		Wessely, Moravia, Austria.	
637	Fell 1831 Sept. 9 3:30 P. M.	Stone. Veined gray chondrite. Fragment with crust and polished surface. Cat. No. 1875.	4
		Weston, Fairfield Co., Connecticut.	
638	Fell 1807 Dec. 14 6:30 A. M.	Stone. Brecciated spherical chondrite. Slab with crust and polished surfaces. Cat. No. 1836.	79
		Mass with crust and two sawed surfaces. Yellow and gray portions contrast strongly in color. Cat. No. 1835.	65
		Whitfield County, Georgia.	
639	Found 1877	Iron. Medium octahedrite. Full-sized, etched section. It exhibits numerous parallel veins of schreibersite. Cat. No. 1119.	125
		Wichita County, Texas.	
640	Known 1836	Iron. Coarse octahedrite. Full-sized, etched section. Troilite and cohenite are prominent. Cat. No. 886.	2,466
		Full-sized, etched section, 18x27 cm. Cat. No. 41.	1,396
		Thin section, etched. Cat. No. 885.	115
		Williamette, Clackamas Co., Oregon.	
641	Found 1902	Iron. Medium octahedrite. Full-sized, etched section. Contains circular troilite nodule 2.5 cm. in diameter. Cat. No. 592.	1,494
		Mass with crust and broken surface. Cat. No. 1195.	923

No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
642	Found 1892	**Williamstown,** Grant Co., Kentucky. Iron. Medium octahedrite. Long, narrow end piece, etched. Cat. No. 1185. Full-sized, etched section. Cat. No. 766.	 975 910
643	Fell 1785 Feb. 19 12:15 P. M.	**Witmess,** Bavaria, Austria. Stone. Spherical chondrite. Fragment with crust. Cat. No. 1876.	13
644	Fell 1795 Dec. 13 3:30 P. M.	**Wold Cottage,** Yorkshire, England. Stone. Veined white chondrite. Fragment from interior with three polished surfaces. Shows veining. Cat. No. 1833. Fragment from interior. Cat. No. 1834. Polished chips. Cat. No. 215.	 10 3 2
645	Recognized 1858	**Wooster,** Wayne Co., Ohio. Iron. Medium octahedrite. Two etched fragments. Cat. No. 1193. One etched fragment. Cat. No. 494.	 10 2
646	Described 1825	**Yanhuitlan,** Oaxaca, Mexico. Iron. Fine octahedrite. End piece, etched. Surface 21x27 cm. No figures are discernible. This slab is evidently from the same individual as the following one, and also bears the name "Misteca." The crust surface is smooth and bright. Cat. No. 963. Full-sized, etched section, 23x29 cm. Figures of a fine octahedrite are dimly outlined in one corner; the remainder appears like an ataxite. Although the slab bears the word "Misteca" etched upon it, the figures class it with Yanhuitlan. Cat. No. 962. Etched slab. Cat. No. 831.	 9,739 7,361 305
647	Found 1875	**Yardea Station,** South Australia. Iron. Medium octahedrite. End piece, etched. The bands are broad and swollen. Cat. No. 935.	73
648	Fell 1852 Jan. 23 4:30 P. M.	**Yatoor,** Madras, India. Stone. Spherulitic chondrite. Mass with crust and polished surfaces. Structure coarse. Metal abundant. Cat. No. 1877.	27
649	Fell 1877 June 17 4:30 A. M.	**Yodze,** Kovno, Russia. Stone. Brecciated howardite. Mass with crust. The black, glassy crust and brecciated interior are striking characters. Cat. No. 1371.	48

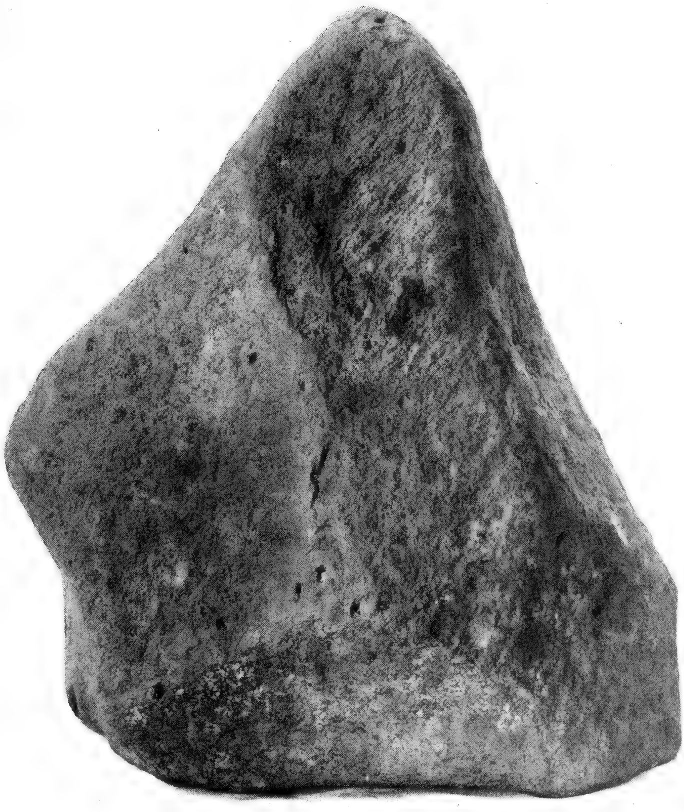
No.	Date of Fall or Find.	NAME AND DESCRIPTION.	Weight in grams.
		Yorktown, Westchester Co., New York.	
650	Found 1869	Stone. This meteorite is generally referred to Tomhannock, but the localities are nearly 100 miles apart and specimens of the two meteorites do not look alike. While nothing seems to be known of the history of Yorktown, there seems to be no good reason for referring it to Tomhannock. Three polished fragments with crust. Cat. No. 1763.	3
		Youndegin, (Penkarring Rock), West Australia.	
651	Found 1884	Iron. Coarse octahedrite. Nearly complete individual. Cat. No. 878.	141,069
		Full-sized, etched section, 18x44 cm. Cat. No. 877.	4,308
		Full-sized, elongated section, 10x27 cm. etched. Cat. No. 118.	1,087
		Full-sized, etched section. Cat. No. 876.	566
		Zaborzika, Volhynia, Russia.	
652	Fell 1818 April 10	Stone. Veined intermediate chondrite. Mass with crust. Cat. No. 1709.	50
		Zabrodje, Wilna, Russia.	
653	Fell 1893 Sept. 22	Stone. Veined intermediate chondrite. Fragment from interior. One polished surface. Cat. No. 1707.	4
		Zacatecas, Mexico.	
654	Found 1792 Iron.	Brecciated octahedrite. Mass with three etched surfaces. Cat. No. 894.	1,246
		Etched mass with crust. Cat. No. 895.	94
		Etched fragment. Cat. No. 28.	5
		Zavid, Bosnia, Austria.	
655	Fell 1897 Aug. 1 10:30 A. M.	Stone. Brecciated gray chondrite. Mass with crust and armored surface. Cat. No. 1860.	384
		Mass with crust. Cat. No. 1861.	293
		Mass from interior. Has broad, armored surface. Cat. No. 1862.	142
		Zebrak, Bohemia, Austria.	
656	Fell 1824 Oct. 14 8 A. M.	Stone. Spherulitic chondrite. Mass with crust. Cat. No. 1708.	14
		Zsadany, Hungary.	
657	Fell 1875 Mar. 31 3–4 P. M.	Stone. Spherical chondrite. Nearly complete individual, one surface polished. Cat. No. 1878.	14



Barratta, Australia. Stone meteorite. Nearly complete individual. The face upon which the mass is resting is an artificial one; the other surfaces are natural. The front side of the mass is shown. Weight of mass 72 kgs. (158 lbs.). This is the largest individual of the fall. Museum No. Me 1456. $\times \frac{1}{4}$.

Barratta, Australia. The individual shown in the previous plate (Plate LX) is here shown turned about 90° toward the rear side. The contrast in the pittings of the front and rear surfaces is thus brought out; also the elongated form of the individual. X1/4.

Blanket, Texas. Fell May 30, 1909. Stone meteorites. Complete individuals. Weight 1.6 and 1.5 kgs. (3.5 and 3.3 lbs.). Museum Nos. Me 1964, 1965. x⅗. Gift of Stanley Field and Arthur B. Jones.



McKinney, Texas. Stone meteorite. Complete individual. Weight 52 kgs. (114 lbs.). Museum No. Me 1438. The concave surfaces are a peculiar feature. X¼.

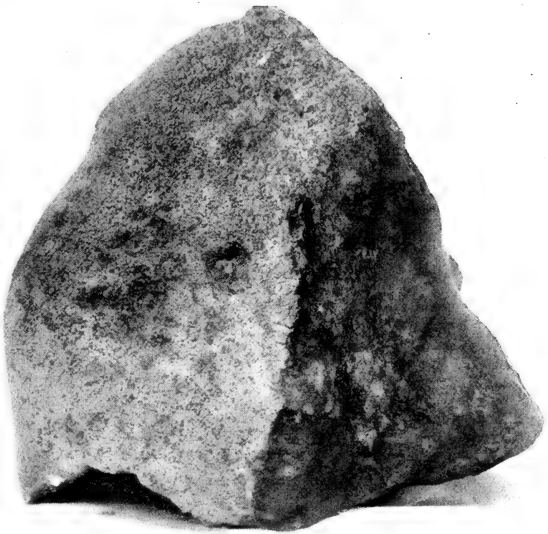


Fig. 1

Bluff, Texas. Stone meteorite. Complete individual. Weight 8.6 kgs. (19 lbs.). Museum No. Me 1461. x$\frac{1}{3}$.

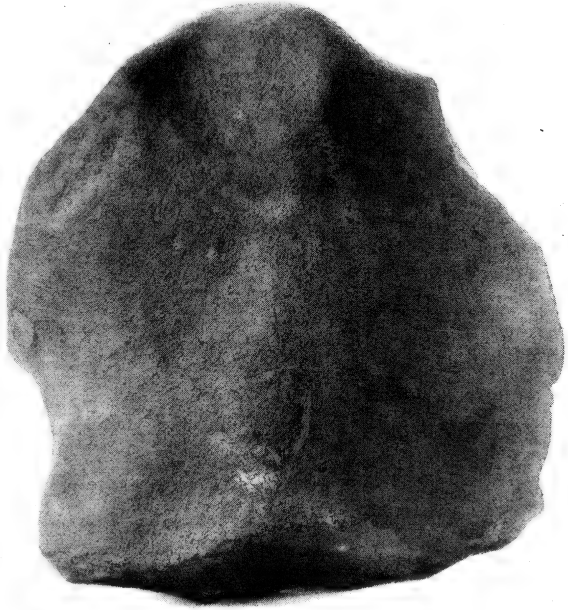


Fig. 2

Plainview, Texas. Stone meteorite. Complete individual. Weight, 2 kgs. (4.4 lbs.). Museum No. Me 1968. x$\frac{3}{5}$.

CASTS OF METEORITES

About 100 casts or models of meteorites, illustrating the size, form and superficial appearance of the original masses form a part of the collection.

The following is a list:

Name	Cat. No.	Weight of Original
Adargas (Concepcion)	425	3,325 kgs.
Akburpur	386	2 "
Algoma (2)	530, 1924	4 "
Babb's Mill	383	140 "
Ballinoo	1923	43 "
Barranca Blanca	466	12 "
Bath Furnace No. 1	602	80 "
" " " 2	566	6 "
" " " 3	591	223 gms.
Bella Roca	380	33 kgs.
Bluff	421	146 "
Boogaldi	600, 1925	2 "
Braunau No. 1	388	17 "
" " 2	381	23 "
Brenham (2)	418, 1937	...
Bustee	387	1 "
Butsura	398	22 "
"	398a	5 "
"	398b	151 gms.
"	398c	9 kgs.
"	398d	4 "
Cabin Creek	411	47 "
Charlotte	470	3 "
Chilcat	1926	42 "
Chupaderos	422	14, 114 "
"	423	6,767 "
Cleveland	410	115 "
Costilla Peak	1927	35 "
Crab Orchard	412	38 "
" "	413	2 "
" "	414	1 "
Cronstadt	471	1 "
De Cewsville	479	340 gms.
Descubridora (2)	426	575 kgs.
Durala	382	12 "
Farmington	419	80 "
Glorieta	408	148 "
Goalpara (3)	402, 1938	2 "
Gross-Divina	385	10 "
Hex River	406	45 "
Homestead	404	...
Iron Creek	763	175 "
Jelica	476	...
Jhung	472	3 "
Joe Wright	407	42 "
Juncal	400	104 "

Name	Cat. No.	Weight of Original
Karakol	1939	3 kgs.
Kenton County	417	163 "
Khiragurh (2)	395, 1940	...
Kingston	799	4 "
Kokstad	429	42 "
Krähenberg	403	16 "
Leighton	1974	1 "
Luis Lopez	1928	7 "
McKinney	1941	100 "
Merceditas	399	43 "
Misshof	1942	6 "
Morito (San Gregorio)	424	11,000 "
Mungindi	1929	28 "
Nagy-Divina	1943	10 "
Nedagolla	473	4 "
Nejed	468	59 "
New Concord	369, 1944	...
N'Goureyma	1922	37 "
Nocoleche	1830	20 "
Obernkirchen	474	41 "
Parnallee	393	58 "
Plymouth	1931	14 "
Puquios	409	6 "
Rancho de la Pila	420	46 "
Rodeo	594	44 "
Roebourne	1932	87 "
Rosario	1933	3 "
Rowton	475	3 "
Saline	525	31 "
Sarepta	391	14 "
Scottsville	401	10 "
Segowlie (5)	390	...
Shelburne	608	6 "
"	609	12 "
Staunton	394	...
Steinbach	397, 1936	...
Supuhee	467	...
Surprise Springs	1934	1 "
Ternera	377	650 gms.
Thurlow	1935	5 kgs.
Welland	416	8 "
Werchne Udinsk	392	18 "
Wichita County	384	145 "
Yanhuitlan	428	421 "
Yatoor	389	13 "
Zacatecas	427	780 "

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CATALOGUE OF THE COLLECTION OF METEORITES

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CHICAGO, U. S. A.
March 15, 1916.